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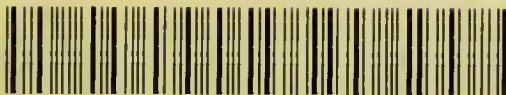
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WORKS BY SIR FREDK. TREVES, Bart.,
K.C.V.O., C.B., LL.D., F.R.C.S.

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BY

SIR FREDERICK TREVES, Bart.
K.C.V.O., C.B., LL.D., F.R.C.S.

*Sergeant Surgeon-in-Ordinary to H.M. the King
Surgeon-in-Ordinary to H.R.H. the Prince of Wales
Consulting Surgeon to the London Hospital*

NEW EDITION

REVISED BY THE AUTHOR AND

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Examiner in Surgery, Royal Army Medical Department*

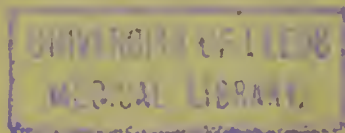
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A MANUAL OF OPERATIVE SURGERY.

Part VII.

PLASTIC SURGERY.

CHAPTER I.

GENERAL PRINCIPLES.

PLASTIC SURGERY concerns itself with the remedy of certain congenital defects and malformations, such as hare-lip, cleft palate, and extroversion of the bladder, and with certain acquired defects and deformities, such as may follow the loss of parts by injury or ulceration, or the contraction incident to the formation of cicatrices.

The term "plastic surgery" appears to have been first used by Zeis about 1836, and although the majority of the operations included in that term are of modern origin, some few of them can claim great antiquity.

There is evidence to show that in the fifteenth century operations for the restoration of the nose were extensively performed. Gasparo Tagliacozzi's great work, "*De Curtorum Chirurgia per Institionem*," was published in 1597, and with the name of this surgeon the Italian method of rhinoplasty has always been associated. Tagliacozzi's operations obtained, however, little hold in the surgical world, and appear to have been soon forgotten. The Indian method for the restoration of the nose is of great antiquity, and owed its origin to the frequent mutilation of the face as a punishment. The practice received little notice from Europeans until after the publication of an article in the *Madras Gazette* in 1794. The first rhinoplastic operation performed in England was carried out in 1803, when the Indian method was employed. Within modern times the progress of plastic surgery has been very rapid, and since the introduction of antiseptic methods in surgery the results obtained have been infinitely improved.

Chelius, who gives an admirable account of the history of this branch of operative work in the second volume of his "Surgery" (South's edition), speaks of Graefe as "the actual creator of plastic surgery in Germany."

With the name of Graefe must be associated the names of Dieffenbach, Blandin, Roux, Langenbeck, Liston, and many others.

General Principles.—1. The common feature which underlies plastic surgery, as the term is usually understood, involves the ready and secure union of refreshed or divided surfaces. The operations for the most part concern the skin, and are dependent upon the vascularity and elasticity of the skin, its mobility, the readiness with which wounds made in it unite, and the comparative ease with which it may be displaced, and with which it moulds and adapts itself to a new situation.

2. In the actual planning of incisions and the mapping out of flaps, little can be done by following blindly any especial method. Each case must be considered upon its merits, and each operation arranged as the needs of the particular case suggest. No branch of operative surgery demands more ingenuity, more patience, more forethought, or more attention to detail. In connection with certain operations it may almost be said that no two cases are alike.

3. As sound and rapid healing is essential in these operations, it is of primary importance that the patient be in the best possible health, and that the tissues in the operation area be free from disease. Scar tissue can never be relied upon, and it is needless to speak of the recklessness of plastic operations in the vicinity of active syphilitic disease, or of lupus, or in aged or broken-down subjects. In many cases the operation cannot be repeated: there is little before the surgeon but success or a condition more lamentable than mere failure. A plastic operation may leave the deformity in a worse condition than it was before the case was approached, and before the prospects of success are compromised the surgeon should be convinced that no possible element of failure has been overlooked.

4. In planning the flaps it is necessary that they be derived from sound tissues, that they be thick and include the subcutaneous tissue, that their vascularity be assured, and that

they be so cut as to inflict the least possible damage upon the arteries which supply them.

The flap must be large enough, and as a rule should be one-sixth larger than the space it has to fill; it must be gently handled, carefully adjusted, and most tenderly and precisely sutured. The pedicle of the flap must not be so twisted or extended as to occlude the nutrient vessel. It is of the utmost importance that there be no undue tension upon the parts, and that the edges of the wound be not merely dragged together.

5. The margins of any surfaces of skin which are to be brought together must be evenly and liberally freshened.

Throughout the whole progress of the case the

strictest antiseptic precautions must be carried out, and the minutest care must be paid to the after-treatment.

In most cases union by first intention is aimed at, but, as is mentioned in a later section, this object may not be essential in all instances.

Methods.—The following are, very briefly, the chief methods made use of in plastic surgery. They must not be considered to represent either a complete system of operations or a series of rigid formulæ, but rather to form the groundwork of such varied procedures as the different classes of cases to be dealt with demand.

1. DIRECT UNION OF FRESHENED EDGES WHICH ARE BROUGHT TOGETHER, ALL TENSION UPON THE PARTS HAVING BEEN RELIEVED.

This is applicable to small sinuses and fistulæ, to narrow linear and spindle-shaped gaps or fissures, and to such defects as the simpler forms of hare-lip

The margins of the fissure or opening are freshened by removing the integument which covers them. The strip of



Fig. 246.—PARALLEL INCISIONS ON EACH SIDE OF A CLEFT.

skin to be removed is grasped and steadied with fine-toothed forceps, while the strip is severed with a narrow scalpel or sharp-pointed tenotome. The portion removed should include not only the skin, but also the subcutaneous tissues, and must be so free that the raw edges which are to be united are made out of sound and vascular structures.

The edges of the fresh wound are carefully cleaned, bleeding is checked by the pressure of a sponge, and the margins are approximated by fine silkworm gut, horse-hair, or silk sutures.

It is often well to leave the wound open for a while, to allow time for any bleeding to cease before the sutures are finally adjusted.

In the case of larger gaps, or of fissures in dense tissues, tension may be relieved by undermining the margins of the wound for a certain distance with the scalpel (subcutaneous detachment). If this be not sufficient, two parallel incisions may be made, one on each side of the cleft, as shown in Fig. 246.

2. THE METHOD BY GLIDING OR LATERAL DISPLACEMENT.

Here the skin and subcutaneous tissues in the immediate vicinity of the defect or gap to be covered or closed are dissected up, and the tongue or strip of skin is so drawn upon and displaced as to occupy the freshened surface of the part to be covered.

In this case also it must be remembered that all edges and surfaces which are to be brought into contact must be liberally freshened. The strips of skin made use of to close the gap must be thick, and must include the subcutaneous tissues. The disposition of the strip must be influenced by convenience, by anatomical circumstances, and the arrangement of the blood-vessels. Bleeding should be checked before the sutures are drawn tight, and undue tension must not be allowed to fall upon the stitches.

A. To close a Triangular Gap.—1. If the gap be small, and form an equilateral triangle, the area may be closed by uniting the sides or angles of the triangle.

2. If the defect be of larger size, one of the following methods may be made use of:—One side of the base of the triangle may

be extended by an incision which continues the line of the base. The tongue of skin so marked out is freed by subcutaneous detachment, and the point of the freed flap is fixed to the angle on the undisturbed side of the base of the triangle. (See Fig. 247.)

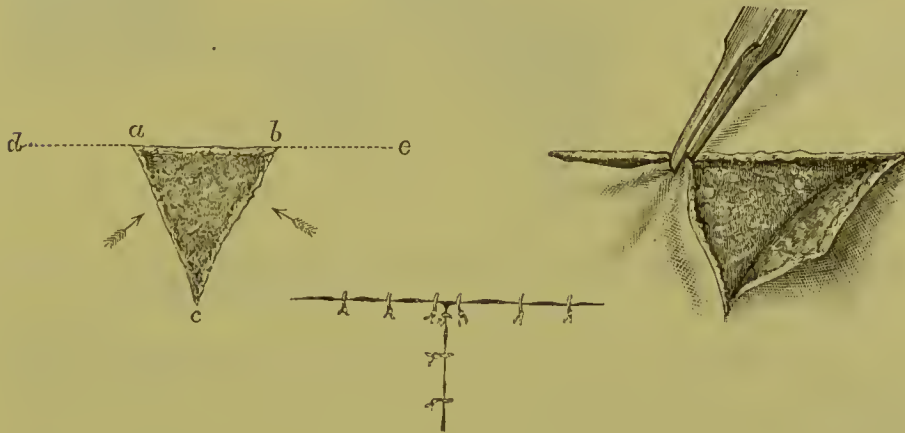


Fig. 247.—(Löbker.)

3. The tissues upon both sides of the triangle may be freed in like manner (Fig. 247), so as to bring the two flaps together, *i.e.* uniting the point *a* to the point *b*.

If necessary, the mobilisation of the tongues of integument may be aided by lateral parallel incisions made beyond the points *d* and *e*.

4. In order to conform with the natural line or disposition of the tissues or features, or to avoid nutrient vessels,



Fig. 249.—JAESCHE'S OPERATION. (Löbker.)

a curved lateral incision (*b d*, Fig. 248) may be made, and the skin at *b* attached to the integument at *a*. This is known as Jaesche's operation.

5. Dieffenbach's method for closing a triangular gap is as follows:—A large quadrilateral lateral flap, *a b c d*, is used to close the defect by displacing it towards the side of the triangle, *a c*, leaving the raw surface, *b d e*, to close by granulation (Fig.

249). If the gap is of any size, it is best to cover it at once by skin grafting.

6. The methods of Dieffenbach and Jaesche may be combined, as is shown in Fig. 250.

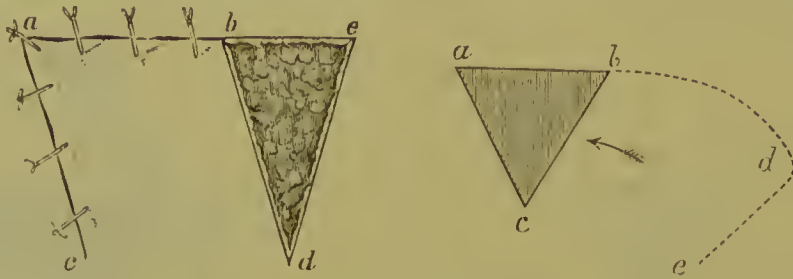


Fig. 249.—DIEFFENBACH'S OPERATION. Fig. 250.—DIEFFENBACH'S AND JAESCHE'S METHODS COMBINED.

7. In Burow's operation for the closure of large triangular gaps, the lateral incisions, *d a*, *b e* (Fig. 251), are first made, the flaps, *d a c*, *e b c* are detached, and are brought together, so that the margin *a c* is united to the margin *b c*. In adjusting these flaps it will be found that their angles are redundant. The exuberant tissues are removed, leaving two new raw surfaces

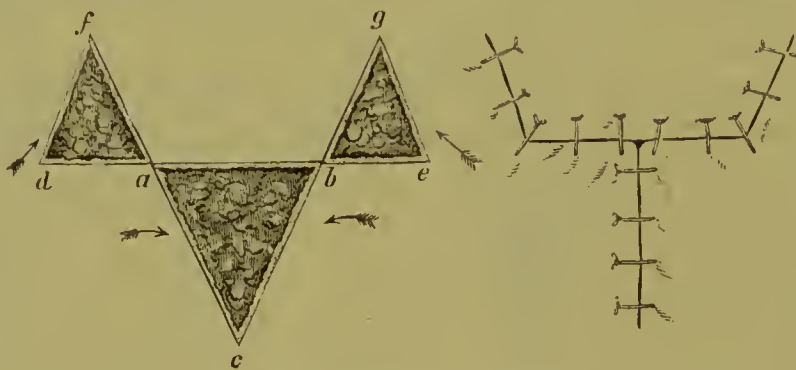


Fig. 251.—BUROW'S OPERATION.

of triangular shape, *f d a*, *g b e*, which, after suture of the main incision, are themselves closed.

B. To close a Quadrilateral Gap.—1. Two parallel incisions in continuation with the longer margins of the wound are made on either side of the area to be covered in: *e a*, *f c*, *b g*, *d h* (Fig. 252). The two flaps, *e a f c*, *b g d h*, are detached, and are united along the margins, *a c*, *b d*. In many cases the formation of one lateral flap is sufficient, or the mobilisation of

the two strips of integument may be aided by parallel lateral incisions, made beyond the attached bases of the two flaps.



Fig. 252.—(Löbker.)

2. *Letenneur's Operation*.—The flap $b e f g$ (Fig. 253) is freed from below, and is displaced upwards until the margin $e f$ can be sutured to the margin $a d$.

3. *Bruns' Operation*.—Two lateral flaps, $a e f g$, $b h i k$ (Fig.

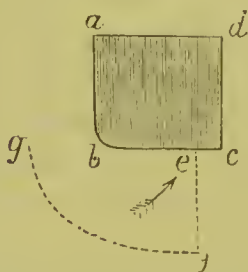


Fig. 253.—LETENNEUR'S OPERATION.

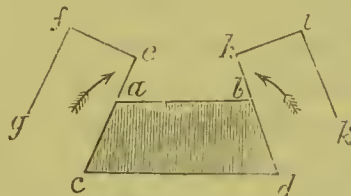


Fig. 254.—BRUNS' OPERATION.

254), are marked out and detached, and are so brought together that the borders $e f$ and $h i$ are united in the median line.

c. To close Large Elliptical Defects.—1. Simple curved flaps, such as $a c d e$, $b c d f$ (Fig. 255), may be cut and freed by

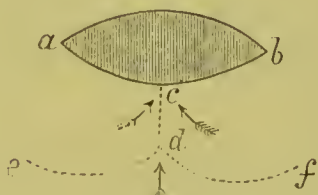


Fig. 255.—SIMPLE CURVED FLAP.

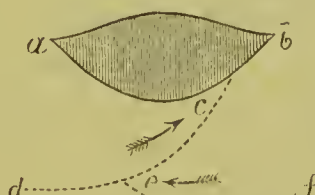


Fig. 256.—WEBER'S OPERATION.

subcutaneous detachment, and may then be displaced upwards, so as to close the raw area.

2. Two flaps, $a c d$ and $b e f$, may be fashioned as shown in Fig. 256, and after detachment may be so adjusted that the point c of the flap $a c d$ is raised, and attached to the angle b , while the gap left by its displacement is closed by the second flap, $b e f$. This is known as Weber's operation.

3. THE METHOD BY FLAP FORMATION.

Some of the methods just described may be properly considered as involving treatment by flap formation, and to be allied to what is known as the Indian operation; it is convenient, however, that the two sets of operations should be kept distinct.

The two chief methods of flap formation in plastic surgery are the Italian and the Indian.

1. **The Italian or Tagliacotian Method** involves the derivation of the flap from a distant part. In the restoration of the nose, for example, the flap may be obtained from the arm. The flap so employed is partially dissected up, and is left attached to the limb by its pedicle. It is in due course adjusted to its new situation, and after it has acquired a vascular connection with the tissues around the area it has to occupy, its connection with the arm is finally severed.

2. **The Indian Method** is understood to involve the derivation of the flap from the neighbouring integuments. Thus, in repairing defects of the nose the flap may be obtained from the forehead or cheek. A pedicle is formed, and the flap is drawn into its new position by torsion or gliding.

These operations are considered in detail in the chapter on Rhinoplasty (page 14).

3. **Other Methods** of disposing of the flaps may be mentioned. In the *reversed flap* the cuticular surface is directed inwards and its raw surface outwards.

In employing *superimposed* or *double flaps*, the outer, raw or exposed surface of a reversed flap is covered by a second flap, the epidermic surface of which is turned outwards.

In Roux's method by *successive migration* the flap is transferred from a distant part by stages. Thus a defect in the lip may be restored by a flap from the neck. This flap is first

twisted transversely into a wound prepared for it, and as soon as union has occurred here is displaced upwards to the lower jaw, and thence to the lip.

Treatment of the Flap.—In dealing with nearly all the cases in which a flap is fashioned, one of two methods may be followed:—(a) The flap may be at once fixed with sutures in its new situation and to the newly-freshened surface prepared for it. (b) The implantation of the flap may be deferred until several days have elapsed, until its vitality is fully assured and until its surface is granulating. The raw surface of the flap is prevented from acquiring attachments during the preparatory stage by the introduction of a piece of carbolised oil-silk beneath it. The detachment of the flap and its final severance may by this means be considerably postponed.

The advantages of this method are these:—The risks of sloughing of any part of the flap, and notably of its edges and free end, are greatly diminished. The flap is tested before it is employed. Instead of being transplanted just after it has been drained of blood and reduced in temperature, the flap is adjusted when it is vascular and the seat of an active repairing process. The treatment is certainly extended over a longer period of time, and involves greater inconvenience and possibly more pain to the patient, but these drawbacks are considered to be more than met by the security given by the delay. This method has been carried out with great success by Thiersch in his operations for ectopia vesicæ (*Zentralblatt für Chirurgie*, 1876, page 504).

The details of this method are considered more fully in the following chapter on the treatment of cicatricial deformities.

CHAPTER II.

OPERATIONS FOR THE RELIEF OF CICATRICIAL DEFORMITIES AFTER BURNS.

THE more gross variety of deformity which results from the contraction of the integuments after severe burns has been the subject of a great number of methods of treatment. It must be confessed that the results obtained have not been proportionate to the ingenuity and patience expended upon the treatment.

The contractions with which this chapter is mainly concerned are situated in the neck, face, or upper extremity. Various methods of extension, by means of screw apparatus, india-rubber bands, weights, etc., have been tried, but with little success.

Much better results follow the methods now to be mentioned, both of them being commenced by a free division of the contracting bands. The latter consist always of scar replacing the skin and subcutaneous tissues, and hence the incisions need not be deep, but must extend widely enough to allow of full extension of the contracted joint. A large bi-convex gap is thus produced, and is filled in at once by either (1) Thiersch skin-grafts, or (2) a flap shaped from comparatively healthy skin and subcutaneous tissue alongside of the cicatrix. The flap is cut to correspond in shape and size with the raw surface, and is swung round on its pedicle into the gap, being secured by fine sutures at its margin. Thiersch grafts are then placed over the area left by moving the flap. Even pressure by an aseptic dressing and several days' rest of the part on a splint are required.

By means of two or more such operations a remarkable improvement can be effected in many cases of contraction after burns.

If the flap required is a large and long one, it will be safest to follow the method introduced by Mr. Croft.

The account which follows is derived from Mr. Croft's paper in vol. lxxii. of the *Med.-Chir. Trans.* (1889).

Mr. Croft has illustrated his procedure by an account of five cases, in all of which the treatment may be considered to have been successful.

The method consists of raising a strip or bridge of sound skin, which is left attached by its two extremities, but which is separated through the rest of its extent from the subjacent tissues by means of oiled silk.

After the process of granulation has been well established, the contracted structures are divided, and the bridge of skin, having been severed at one extremity, is made to occupy the gap formed by such division. The operation is indeed a flap operation, in which the attachment of the flap in its new situation is deferred until granulation has occurred.

The Operation as carried out by Mr. Croft.—The strip or bridge of skin to be raised is cut where it can be taken free of scar tissue and well supplied with blood, yet sufficiently near to allow of its being twisted into its new bed. In the neck the bridge of skin may measure eight or nine inches in length. These bridges are cut as thick as possible, especially in their central parts (Fig. 257).

The bleeding from the flap and wound is carefully arrested before dressings are applied.

The sides of the wound are approximated by sutures, but tension from the stitches is avoided as much as possible.

With the object of promoting approximation or preventing retraction of the edges, these are sutured to the muscle and fascia near the centre of the gaping wound.

This fixation of the edges is of assistance in limiting the extent of surface which has to heal by granulation.

The strip or bridge is left attached at either end.

The under-surface and edges of the bridge are to become covered by granulations. Care must be taken to prevent it from re-uniting, and especially that granulations do not spring up in the angles formed between the pedicles and the raw surface.

In this situation there is not a little risk that the length of the span may become insidiously shortened.

A layer of oiled-silk protective, well sterilised, is inserted between the raised skin and the parts beneath it, and is carefully drawn under the pedicles.

The whole operation area is covered with a light antiseptic dressing, and the part is so secured as to keep the entire region

at rest. A rigid fixation apparatus may be required, especially in young patients.

If all goes well, and no complication occurs, in a fortnight or three weeks' time it will be safe to proceed to the next stage of the operation — viz. that of cutting across the contracted scar and transplanting the strip of skin. In



Fig. 257.—CROFT'S OPERATION FOR THE RELIEF OF CICATRICIAL DEFORMITY AFTER BURNS : POSITION OF BRIDGES OF SKIN IN A CASE OF BURN OF THE UPPER LIMB.

judging of the right moment for beginning the second stage, the surgeon must take into account the condition and extent of the granulating wound, the fresh loss of blood which must ensue in making a bed for the transplant, the extent of this fresh wound, and the influence that the operation will have upon the vitality of the transplant, which must now depend on one pedicle instead of on two.

At this second operation it is better first to cut through the contracted scar, and afterwards to cut across one end of the bridge. In dealing with the scar no tissue should be sacrificed. The scar tissue should be divided until healthy fat, fascia, or

PART VII.] *CICATRICIAL DEFORMITY AFTER BURNS.* 13

muscle is reached. All bleeding should have ceased before the final fixation of the transplant.

The bed and the flap must be made to agree in length, and for the most part in width, but the shape of the fresh wound cannot always be made to correspond exactly with the shape and extent of the transplant.

The form of the bridge will now have considerably changed from what it was when it was first cut. It will have become shorter and narrower and thicker.

The strip must be to a certain extent trimmed. The edges and granulating under-surface at the free end, for a distance of about half the length of the strip, should be pared or freshened, so that a raw surface is presented for primary union.

In none of Mr. Croft's cases did the transplant correspond in its uniform width to the width of the bed for it. The latter always varied, except at the part which was to receive the free half or third of the flap.

It is enough to obtain primary union between the free end of the flap and the fresh wound. This union anchors the strip and fixes it in its place.

Union along the rest of the extent of the transplant is only a work of time. At first the transplant looks very ungainly and unpromising. As week after week goes by and healing takes place, the sausage-like thing flattens down and spreads out, until finally it may become twice as wide as it was originally cut.

The part of the transplant which causes anxiety is the distal inch of it. This may slough to a slight extent, and union may therefore fail to take place. In consequence of this the strip may retract from its holding. It must then be kept in place by the troublesome process of strapping.

After healing has taken place, the surgeon must wait for about six months before he can judge of the final result of his operation.

CHAPTER III.

RHINOPLASTY AND OPERATIONS FOR HARE-LIP.

A VERY large number of plastic operations, most of them ingenious and all more or less complex, have been designed to repair defects of the nose. The defect may be due to congenital deformity, or may depend upon injury, or upon the results of lupus, syphilis, or other destructive forms of ulceration. Any operation is contra-indicated in the case of partial or complete loss of the nose, the result of cancer.

The main flaps out of which the new organ is formed may be derived from the forehead, the cheek, the arm, or forearm. It is seldom that the whole of the nose is destroyed, and it will be evident that the least successful results follow in cases in which the bony parts of the nose have been lost.

In *complete rhinoplastic operations* it is assumed that the whole of the cartilaginous part of the organ, including the tip, the columna, the alæ, and more or less of the septum, is lost.

Partial rhinoplasty concerns itself with slighter defects, and is employed to replace the tip of the nose, or one ala or part of the septum, or to close a fistulous opening in the skin of the member.

Many of these minor operations are very successful, but many of the procedures which aim at the restoration of the entire nose do not give brilliant results.

Among the most excellent results obtained by rhinoplasty must be placed the very admirable series of cases published by Surgeon-Major Keegan in the *Lancet* for Feb. 21st, 1891. (See Figs. 263 and 264.)

In cases in which the bony framework of the nose has been lost, or in which the patient is the subject of a "depressed

nose"—as in congenital syphilis—the results are almost entirely unsatisfactory. An unsightly gap in the face may be closed in the one case, it is true, but it will be covered in by a flap of skin which is in time level with the cheek. In the case of the depressed nose it is a question whether the "improvement" merits that term, and to replace a flat area of integument by a rudimentary and imperfect ridge is to effect a change in the features of doubtful advantage.

It is probable that better results may follow the injection—at a later period—of paraffin under the new flap of skin.

Even in cases in which the nasal bones have survived, the results have often little to commend them. The new nose may be large and bulbous, or puny and abortive, and a feature which is unsightly may be replaced by one which is simply ridiculous. In the operations which involve the formation of a flap from the tissues of the face much additional disfigurement may result from an unsightly scar on the forehead or the cheek.

The results, however, obtained since improved methods of treating wounds have been introduced are certainly more encouraging.

It is true that the tissues of the face are admirably adapted for plastic procedures, and the actual surgical results, so far as healing is concerned, are often all that could be wished.

Before proposing a complete rhinoplastic operation, the use of an artificial nose carefully fashioned and coloured should be considered.

Within the last few years remarkable improvements have been effected in the manufacture of these artificial features. Though even the best look unnatural, they are at least symmetrical and well-shaped, and do not look ridiculous.

By means of a spectacle-frame a very fair attachment of the upper part of the new member can be obtained, and in adult males a false moustache may be made to secure the lower attachment.

The special elements of failure in rhinoplastic operations are gangrene or sloughing of the flap, imperfect healing, secondary hæmorrhage, shrinking, or persistent œdema or distortion, of

the attached flap, and, lastly, a recurrence of the original disease.

COMPLETE RHINOPLASTY.

A selection from the extremely numerous operations embraced by this title will be considered under the following headings:—

1. The Indian operation (flap taken from the forehead).
2. The Italian operation (flap taken from the upper limb).
3. The French operation (flap taken from the cheek).
4. Other operations.

1. **The Indian Operation.**—This procedure, as modified by modern and especially by German surgeons, may claim to be

at present the best rhino-plastic operation. The flap is derived from the forehead, and is brought into place by torsion. One great objection to it is that a large and unsightly scar is left on the forehead. The operation is not applicable to cases in which the tissues of the forehead are unsound or are the seat of cicatrices.

First Stage.—The edges of the defect must be well and evenly freshened. The best results follow when the gap is triangular in

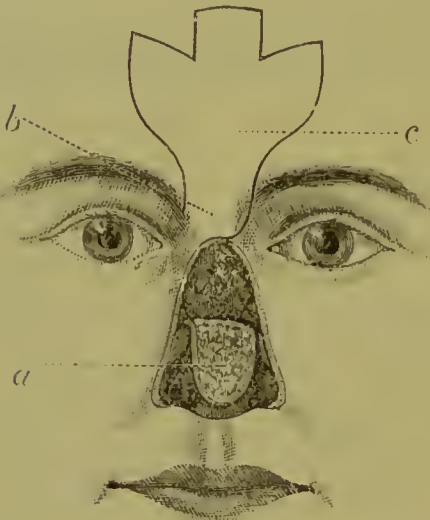


Fig. 258.—RHINOPLASTY.

a, Nasal flap; *b*, Pedicle of frontal flap;
c, Frontal flap.

outline, and in any case the outline of the area to be covered in should be made as nearly as possible triangular, the base of the triangle being towards the upper lip.

Second Stage.—When possible, a small thin flap should be formed from the skin of the root of the nose. This flap should be quadrilateral, with the base or attached side downwards. It should be detached and turned downwards (*a*, Fig. 258), so that its raw surface is directed forwards.

This flap can only be used when the skin over the nasal bones is sound and healthy. It serves to increase the solidity of the new nose, and to form a further attachment for the frontal flap.

Third Stage.—The frontal flap is made. A model of the new organ should have been already fashioned in thin gutta-percha or plaster. This model when flattened out is laid upon the forehead, and, guided by its outline, the flap is marked out. The flap should be about a third larger than the area of the defect, or in marking it out in ink upon the forehead a quarter of an inch may be allowed on each side of the prepared model. Enough tissue must be provided to allow for the alæ and columna. The upper extremity of the flap will reach about to the border of the scalp. If the forehead be low the flap will encroach upon the hair.

The apex or narrow part of the flap will be, of course, at the root of the nose. The flap should include all the tissues down to the pericranium, which must not be disturbed. It must be dissected up boldly and freely.

The formation of the pedicle or apex of the flap is important.

It is well that the incision marking one side of the flap should be continued downwards into the recently freshened area (*b*, Fig. 258).

By means of this incision the pedicle can be lifted from the bones, and will contain the supratrochlear artery of one side. It is impossible that the pedicle can be so made as to include the arteries of the two sides; and if the plan just described be adopted, the compression of the artery by the torsion of the pedicle is reduced to a minimum.

The side selected for the pedicle must, of course, depend upon circumstances. Its width will be from 1 to $1\frac{1}{2}$ cm. The incision marking the other side of the pedicle will end at the inner side of the eyebrow, as shown in Fig. 258.

The flap is usually placed in or about the median line. Some surgeons, and notably Dr. Keegan, direct the long axis of the flap obliquely, so that its tissues are derived mainly from one side of the forehead only. By this means it is considered that the risk of compressing the artery of the pedicle by torsion is minimised. The placing of the flap so obliquely that its long

axis is nearly parallel with the eyebrow is, however, to be condemned.

The including of the pericranium in the flap, under the impression that it would produce bone in the new situation, is a perfectly valueless proceeding, and may lead to some exfoliation of the frontal bone.

The indisposition of the pericranium to form new bone is well known.

All bleeding must be arrested by sponge pressure or pressure forceps. No ligatures should be employed.

The shape of the flap may now be considered.

The outlines here described are those of (a) the triangular flap, (b) the pyriform flap of Dicffenbach, (c) Langenbeck's flap, and (d) Keegan's flap.

(a) The triangular flap conforms to the

original plan of the operation, and is the basis of the many modifications.

Its outline is shown in Fig. 259, which represents the full size for an adult. The line *d d* indicates the median line of the dorsum of the new nose.

The upper border of the flap is divided into three parts by the two vertical incisions *a c*, *a c*.

The median part is utilised to form the columna, and the two lateral parts to form the alæ.

The length of the central part must depend upon the profile of the features.

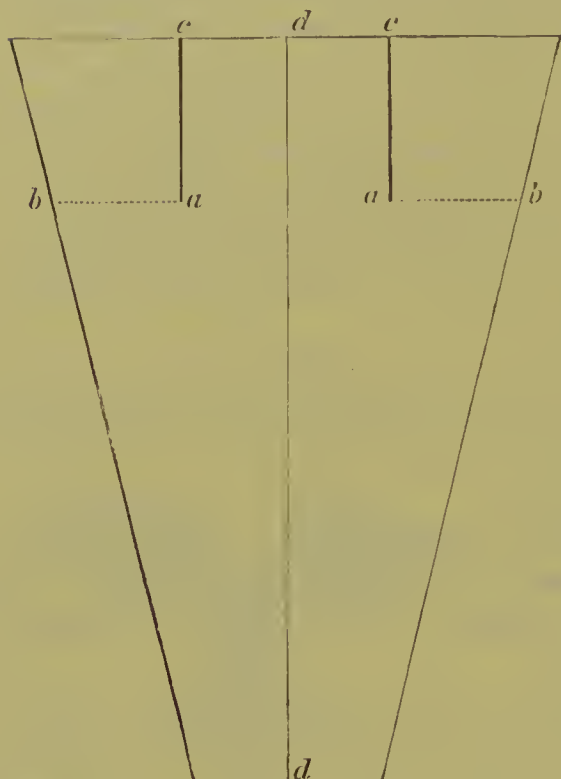


Fig. 259.—RHINOPLASTY: THE TRIANGULAR FLAP.
(Natural size.)

The lateral flaps are bent backwards along the lines ab , ab , so as to conform to the outline of the alar part of the nose. A narrow wedge-shaped piece of skin will probably have to be excised along the lines ac , ac .

(b) The pyriform flap of Dieffenbach is formed upon the same plan as the above, its proportions are estimated in the same way, and the pedicle is arranged in the same manner. The outline of the flap is shown, of natural size, in Fig. 260. The incisions ac , ac are made as before, in order to mark off a central segment for the columna. The lateral flaps are bent back in the direction of $c'c'$, and are utilised to form the alæ.

(c) Langenbeck's flap has the outline shown in Fig. 261 (natural size). In its general proportions and in the disposition of its pedicle it follows the

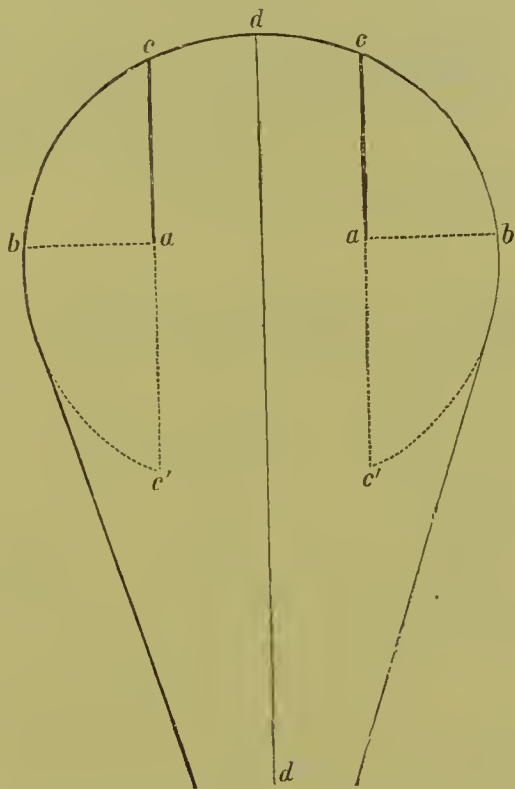


Fig. 260.—RHINOPLASTY: DIEFFENBACH'S FLAP.
(Natural size.)

rules already laid down. The central segment ac , ca forms the columna, the lateral segments—which are bent backwards along the lines ab , ab —the alæ. This flap is in many respects the best of those described.

(d) Keegan's flap is described on page 23.

Fourth Stage.—The frontal wound is closed as far as is possible. If the triangular flap be used, the raw area can be closed in to a considerable extent. In Dieffenbach's flap the area can be but little diminished, while the most complete diminution of the raw gap can be effected when Langenbeck's or Keegan's method has been employed.

Fine hare-lip pins and silkworm-gut sutures may be used for this part of the operation.

At a late period Thiersch's method of skin-grafting may be employed.

By dealing with the frontal wound at this stage the bleeding is considerably diminished, and the surgeon has a clearer field for the manipulation of the flap.

Fifth Stage.—The flap is fixed into its new position. It is carefully twisted, and during this step the surgeon must hold in

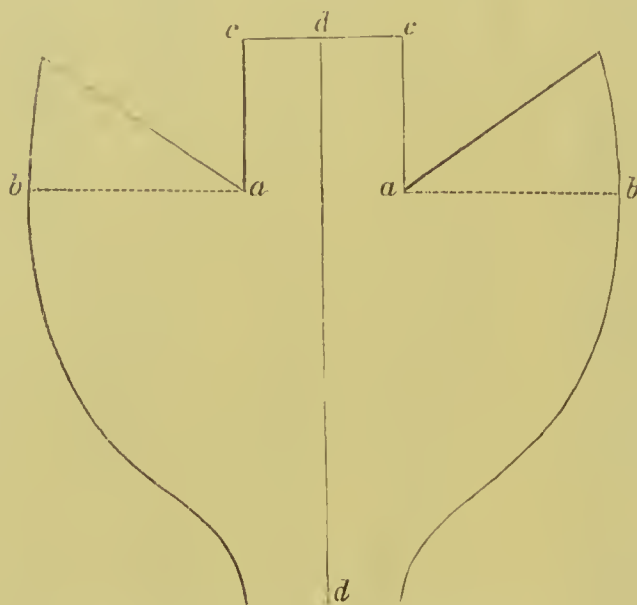


Fig. 261.—RHINOPLASTY : LANGENBECK'S FLAP
(Natural size.)

mind the possibility of occluding the nutrient artery by torsion.

The flap is secured in place by interrupted sutures of silkworm gut. These must not be too closely inserted, and no traction must be made upon them. The lateral parts of the flap are secured first, then the columna, and lastly the alæ.

If the columna has been provided for in the frontal flap as above described, then a suitable groove must be cut in the median part of the upper lip to receive it. If no columna can be obtained from the tissues of the forehead, then it must be formed from the upper lip (page 21), either at once or at a later period.

If no columna be fashioned at this stage, then the flap must be carefully supported by a light plug of gauze, which should be changed frequently. If the septum of the nostrils be restored, then each of the new nostrils must be supported with pieces of drainage-tube of suitable size. These must be retained in position for some weeks.

A simple dry antiseptic dressing is applied, which is secured in place by a light gauze bandage.

The After-treatment is conducted upon general principles. Portions of redundant flap may have to be excised, or some slight secondary operations undertaken to improve the appearance of the new organ.

The pedicle may be severed at the end of three to four weeks, and the wrinkled portion of protuberant skin which marks its position is excised in the form of a wedge-shaped piece, to prevent the formation of a parrot-shaped nose.

Extensive skin grafting will be required for the granulating surface on the forehead.

Modifications of the Operation

(1). *The Frontal Flap may be Partially Detached at First*, and may have its upper attachment severed after its raw surface is granulating, and be then twisted into its new situation.

This modification has been already described (page 9).

Although this plan is admirably suited for some plastic operations, notably for such as are concerned in the relief of deformities produced by burns, it does not appear to be well adapted for this form of rhinoplasty, and it is to be noted that nearly every surgeon who has advocated the Indian method has carried out the immediate adjustment of the flap.

(2). *The Formation of a New Columna from the Lip*.—In the description given above, provision for the new columna is made in fashioning the frontal flap. If, as is often the case, especially in patients with low foreheads, it is not possible to form the new septum from the frontal tissues, the columna may be taken from the lip.

A narrow vertical strip (*b c*, *b c*, Fig. 272) of the median part of the upper lip is isolated by means of the scalpel.

This strip will be about one-fourth of an inch in width, will be quadrilateral, will be equal in length to the depth of the lip, and will include at its free end a part of the red margin of the lip. The little flap will be entirely free, except at its upper or nasal extremity, and to ensure its freedom the frænum of the lip, and the reflections of the mucous membrane from the lip to the maxilla, must be severed.

During the cutting of this thick but narrow strip of tissue the coronary arteries should be compressed by an assistant.

In males it is well to dissect off the skin, and with it the hair follicles.

The tip of the little flap is freshened, and is drawn forwards and fixed *in situ* to the tip of the nose.

It will be seen that the cutaneous surface of the flap forming the new columna is turned upwards, *i.e.* looks toward the nasal fossæ, while the mucous surface is directed downwards, *i.e.* looks towards the chin. The flap is merely bent upwards, and is exposed to no torsion. The mucous membrane in time becomes thickened, and resembles skin.

After the columna has been fixed in position the gap in the upper lip is closed with sutures.

Volkman, Bennett of Dublin, and others, are opposed to the formation of a special columna. They point out that the contraction of the deep surface of the frontal flap leaves an orifice none too large for the admission of air. The flap is allowed to hang freely downwards, and its extremity is not secured by sutures. The contraction of the flap leads to the formation of a definite tip to the new nose, the appearance of which, it is claimed, would not be improved by a columna.

(3). *Operations to Prevent Depression of the New Nose* have led to numerous ingenious experiments and to many modifications of the original operation.

Supporting plugs of amber or of gold have been employed, and various "nasal levers" have been devised, but the retention of these foreign bodies has caused intolerable irritation and ulceration.

The late Mr. William Anderson, however, succeeded in forming a support by bent silver wire fixed into the remains of the septum and the superior maxilla. In two cases this wire support was retained without irritation.

Thiersch made two small longitudinal skin flaps from the edges of the gap to be closed, and, turning them both inwards, united them in the median line. The integumentary surfaces of the little flaps were thus turned inwards, the raw surfaces outwards. Upon this raw surface the frontal flap was

allowed to rest, and from this small under-flap it obtained support.

Langenbeck cut, with a fine saw, lateral pieces of bone from the osseous margins of the nasal aperture. These, when sufficiently separated, were lifted up with an elevator, and were so placed with reference to one another that they acted like the beams of a roof to support the alæ and apex of the new nose.

Recent experience points to the probability that an efficient support may be provided by paraffin.

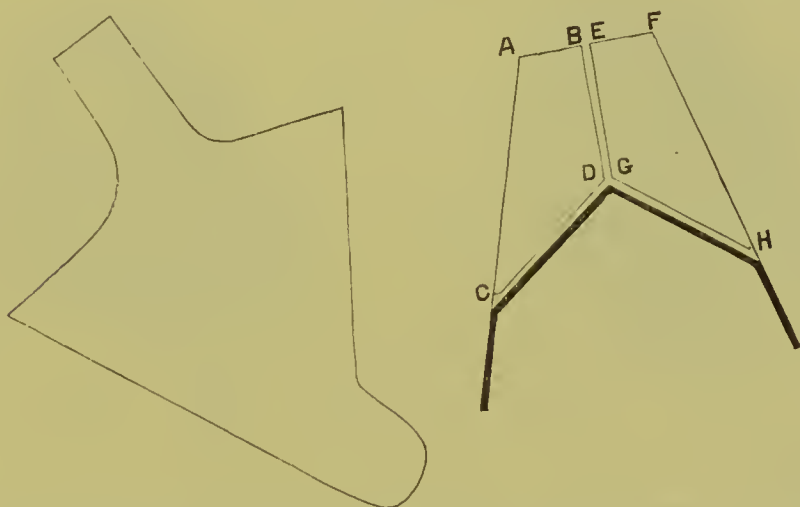


Fig. 262.—RHINOPLASTY. KEEGAN'S OPERATION: THE FLAP IS REDUCED IN SIZE.
(From the *Lancet*, Feb. 21st, 1891.)

(4). *Keegan's Operation*.—This method of rhinoplasty is thus described by Surgeon-Major Keegan in the *Lancet* for Feb. 21st, 1891 :—

The operation is begun by carrying two converging incisions (C A, H F, Fig. 262) from two points slightly external to the roots of the alæ nasi to two points about three-quarters of an inch apart on the bridge of the nose, where a pair of spectacles would rest. These two points on the bridge of the nose are now joined by a horizontal incision, A F. This horizontal incision is bisected, and a perpendicular incision (B D, E G) is drawn downwards from the point of bisection nearly as far as where the nasal bones join on to the cartilage of the nose. In other words, this perpendicular incision follows the course of the

junction of the nasal bones, but is not carried down as far as their inferior borders. The skin and tissues are now dissected cautiously from off the nasal bones from above downwards in two flaps, *A B C D* and *E F G H*, as in Fig. 262.

The two inferior borders of the flaps—viz. *C D* and *G H*—are not interfered with, and constitute the attachment of the flaps to the structures and tissues which clothe the inferior borders of the nasal bones, where they join on to the cartilage of the nose. If these two flaps are reflected downwards, so that their raw surfaces look forwards and their cuticular surfaces look backwards, it will be found that they overlap in the centre. The surgeon has therefore a redundancy of flap to deal with, a redundancy which he can utilise a little later when he has raised the flap from the forehead. He now proceeds to do so in the usual way. The root of the pedicle occupies the internal angle of the eye. The flap is inclined obliquely, and its outline is shown in Fig. 262. The pericranium is not disturbed. The sides of the gap now left in the forehead are approximated as quickly as possible by means of horsehair sutures, and it is surprising how small a raw surface is left behind on the forehead if the approximation of the sides of the gap be judiciously and expeditiously carried out. Attention is now directed to preparing a nidus or bed for the reception of the columna, and this does not require any description. The two flaps, *A B C D* and *E F G H*, which have been already raised from off the nasal bones, are now reflected downwards, and, as they overlap in the centre, two triangular-shaped pieces are cut away and placed in the middle of the gap left in the forehead, in order to expedite the process of cicatrisation in the frontal scar. The forehead flap is now brought down over the nasal bones, and rests inferiorly on the two reflected flaps, *A B C D* and *E F G H*, taken from off the nasal bones. The raw surface of the frontal flap, inferiorly, lies on the raw surfaces of the two reflected nasal flaps, and the nostrils of the newly-formed nose are therefore lined inside with the skin or cuticular sides of the reflected nasal flaps. The free inferior margins of the forehead flap and the nasal flaps are now brought together by horsehair sutures. The columnar portion of the forehead flap is now fixed in the

bed prepared for it by sutures, and the two original incisions drawn from the root of the alæ nasi on either side to the bridge of the nose are now deepened and bevelled off for the reception of the sides or lateral margins of the forehead flap. The sides or lateral margins of the forehead flap are most accurately attached by means of horsehair sutures to the bed prepared for them. Two pieces of drainage-tubing are inserted in the newly-formed nostrils. Strips of lint on which some boracic ointment



Figs. 263 and 264.—KEEGAN'S METHOD OF PERFORMING RHINOPLASTY: PORTRAITS OF THE SAME PATIENT BEFORE AND AFTER OPERATION. (From the *Lancet*, Feb. 21st, 1891.)

has been smeared are placed over the junction of the lateral margins of the new nose to the cheeks, and also on the gap left behind on the forehead, and cotton-wool is applied over all.

Dr. Keegan divides the pedicle of the new nose at the end of a fortnight. The drainage-tubes which occupy the new nostrils are removed after ten days.

Dr. Keegan's paper is illustrated by a number of portraits of patients before and after operation, and the results obtained are in every respect most admirable. One of the portraits in question is reproduced in Figs. 263 and 264.

Verneuil's Operation, for the treatment of "depressed nose," by means of a modified frontal flap, is described on page 32.

2. **The Italian Operation.**—This elaborate operation is very rarely performed at the present day, and is only considered to be indicated when the tissues of the forehead or of the cheek are not available for the formation of a flap.

The procedure is throughout extremely irksome. The flap obtained is not so well adapted for rhinoplasty as is a flap obtained from the forehead, and undergoes very considerable shrinking and atrophy. It would be of little purpose to give any description of the original operations as they were carried out in the sixteenth century.

The only notable example of the Italian method in recent times is, so far as I am aware, that carried out by Sir William Mac Cormac in 1877.

The procedure cannot be better illustrated than by a transcript of Sir William Mac Cormac's account (*Clin. Soc. Trans.*, vol. x., 1877, page 181). The patient was a girl of sixteen, and the loss of the nose was the result of an accident.

The Apparatus.—This is shown in Fig. 265. "A pair of ordinary stout well-fitting stays were first procured, to which were attached two perineal straps to prevent displacement upwards. A helmet, partly made of leather, was connected with the stays by a leather band running up the centre of the neck and back. A leather armpiece, strengthened by a steel band, was moulded so as to extend from the wrist to the shoulder, where it was buckled to the stays.



Fig. 265.—RHINOPLASTY BY THE ITALIAN METHOD: THE APPARATUS IN POSITION. (Mac Cormac.)

The wrist and hand were fastened to the helmet by a gauntlet, while the elbow could be fixed steadily in any required position by straps running from it to the stays and to the sides of the head-piece, so that there was nowhere any undue strain, the pressure being so evenly distributed that each strap was almost slack.

"This apparatus was kept applied for some days beforehand, so that any point of undue pressure might be discovered and remedied."

The Operation.—"The first part of the operation was performed on February 12th, 1877. A flap was mapped out on the inner aspect of the left upper arm, more than double the actual size of the estimated deficiency. The left arm was the one chosen to supply the flap, and the right side of the nose the one first operated upon, the septum being fashioned at the same time. The flap

was left attached at the upper part of the arm by a broad, long pedicle, and so arranged that there should be no traction whatever upon it, whilst the raw surface from which it was taken should be accessible for daily dressing. With the flap I dissected up the subcutaneous fat down to the muscular sheath. Immediate retraction, both of the flap and of the denuded part of the arm, took place to a large extent, so that the raw surface on the latter was almost co-extensive with the whole inner aspect of the girl's arm, the flap appearing quite small in comparison.

"I now made a slightly-curved incision, nearly parallel to the free border of the nose on the right side, and about three lines above it—corresponding, in fact, to where the alar furrow should normally exist.

"This incision was prolonged some little distance into the cheek in the line of the cheek furrow, whilst the remains of the septum were split open in the median line. This nasal flap could now be turned down so as to become horizontal, or rather a little depressed beneath the horizontal line, to allow for retraction of the ingrafted piece. A triangular gap, the apex pointing towards the cheek, was thus left exposed on the right lateral aspect of the nose, and into this the triangular-shaped piece from the arm was inserted, and accurately attached by suture, the portion to form the septum being sutured in the groove already mentioned, formed by splitting the septum. In this way there was no paring of edges, nor was a single particle of the nose tissue sacrificed.

"The flap had a large line of attachment. Some suppuration followed on the eighth day. Sound healing of the flap did not take place for nearly three weeks. At the end of this time the base of the flap was detached from the arm. It was cut so as to have a triangular shape, and the left side of the nose was prepared to receive it in a manner precisely similar to the right. In the gap thus formed the detached portion was adjusted and sutured.

"Complete healing of this second part took place in fourteen days.

"The apparatus caused scarcely any inconvenience after the first forty-eight hours. The arm, when released, was stiff and painful, but soon recovered itself. The patient slept well during the treatment.

"The nostrils were kept dilated by short pieces of tubing. For the first three weeks after the completion of the operation much contraction took place in the new nose. Since then little change has ensued."

Woodcuts showing the state of the patient before and after the operation are given in Sir William MacCormac's paper. It may be a question with some whether the girl's appearance has been improved or not by the treatment.

In many accounts of the operation it is advised that the procedure be conducted by the following stages:—

1. The flap is dissected up as a bridge, and is allowed to granulate for fourteen days, a piece of oiled silk being inserted beneath it. (See Croft's operation, page 11.) This flap will measure about five inches by four inches, and will be attached at its extremities only.

2. The upper attachment of the flap is divided, and the flap itself is allowed to lie undisturbed for a few more days.

3. The margins of the defect are pared and are made ready to receive the flap. The apparatus is applied, and the arm is brought into contact with the face.

4. At the end of from ten to twenty days the lower attachment of the flap is severed, the apparatus is left off, and the arm set free.

5. A columna is fashioned from the lower lip (see page 21), and such other steps are taken as are needed to complete the new nose.

This measure has certain distinct advantages over the operation already described as carried out by Sir William MacCormac, and is more in conformity with the recent principles which have guided plastic surgery.

3. The French Operation.—In this procedure rhinoplasty is performed by the transposition of lateral or facial flaps.

The method is of great antiquity, and was described by Celsus. It has undergone extensive modifications in modern times, and has been especially favoured by French surgeons.

The operation is considered to be best suited for cases in which the upper part of the nose remains intact.

The frontal scar is avoided, but the tissues of the cheek

are found by experience to be but ill adapted for the formation of a substantial flap which will not undergo exceptional shrinking.

The new nose is apt to be quite flat, and its vascular supply is feeble, since the arteries of the flap which are derived from the facial are cut in the operation.

Hæmorrhage is very free during the cutting of the flaps.

A cicatrix of a somewhat prominent character is left upon the cheek of either side, and a scar marks the median line of the new nose.



Fig. 266.—SYME'S METHOD OF RHINOPLASTY: THE FLAP FROM THE CHEEK.

(A) *Syme's Operation*.—A large symmetrical flap of the shape shown in Fig. 266 is marked out on the cheeks. Its size is regulated by the rules already given (page 17), and by the dimensions required for the new organ. The pedicle of the flap is median, and is placed above at the root of the nose and between the two inner canthi.

The area to be covered having been freshened, the bilobar flap is freely dissected up, and when all bleeding has been checked, the two lobes of it are united in the median line, while its outer margins are sutured on either side to the raw surface at a proper distance from the nasal orifice.

The edges of the wounds left in the cheeks must be brought together, as far as is possible, by sutures, the triangular gap which will remain on each side close to the new nose being left to close by granulation aided by skin grafting (Fig. 267).

The contraction produced by the healing of these triangular gaps often enhances the apparent height and prominence of the new organ. The nostrils of the new nose must be supported for a time by a plug of gauze or by short pieces of drainage-tube.

Mr. Bell advises that if any part of the old septum remain, it may be made use of as a fixed point. A straight needle is thrust through one lobe of the flap close to its outer lower edge, is then passed through the septum, and is finally brought out at a corresponding point on the other lobe of the flap.

(B) *Nélaton's Operation*.—This surgeon marked out two thick trapezoidal flaps from the cheeks.

Each flap is intended to form the corresponding half of the new nose. The pedicles of the flaps are situated above, near the lachrymal sac, while their bases are below. Each flap contains all the soft parts down to the bone, including the periosteum, which is stripped off the exposed portions of the ascending parts of the superior maxilla on either side.

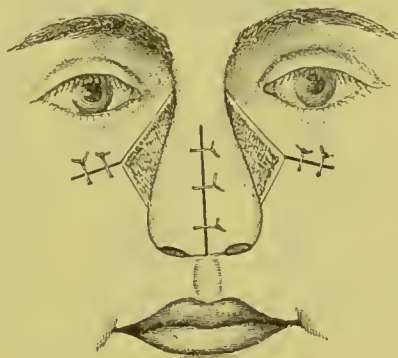


Fig. 267.—SYME'S METHOD OF RHINOPLASTY: THE FLAPS IN POSITION.

The flaps are sutured together along the median line, and are attached also by their outer margins as in Syme's procedure.

The sides of the nose are supported and kept in contact by a hare-lip pin, which is passed through both alæ, while the parts transfixed are compressed by means of a pince-nez, which is steadied by the steel pin.

The results of these operations have not been very satisfactory.

4. Other Operations.

(A) *Ollier's Operation*.—A short account of this method is given by Dr. Joseph Bryant, in his "Manual of Operative Surgery," in the following words:—

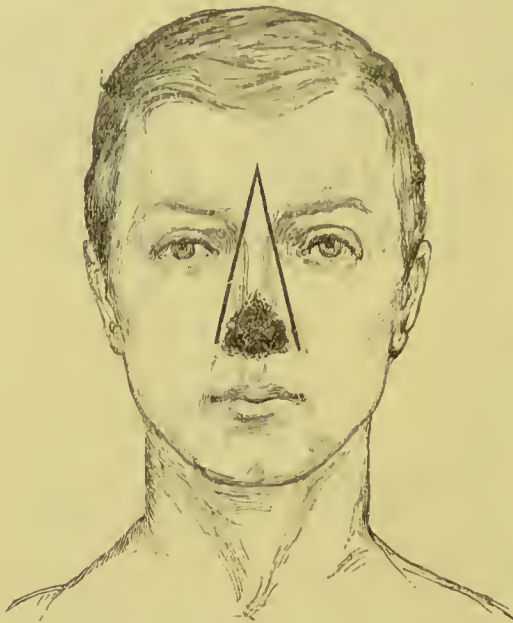


Fig. 268.—OLLIER'S METHOD OF RHINOPLASTY.

"An operation was performed for a deformity caused by the loss of the alæ, columna, cartilages, lobe, and a portion of the septum, due to lupus. The nose was not more than an inch long, due to arrest of development of the ossa nasi, to which was attached a strip of cartilage. The integument of the lip and cheeks had been involved, and could not therefore be depended upon for flaps.

"Ollier commenced two diverging incisions in the median line of the forehead, two inches above the eyebrows, and carried them downward to within one-fourth of an inch from the outer side of the nasal orifice (Fig. 268).

"The upper portion of the triangular flap included the corresponding portion of periosteum down to the upper end of the nasal bones. The dissection was continued along the right nasal bone, omitting the periosteum, down to its lower end, from which the cartilage was separated; but it remained attached to the flap. The left nasal bone was separated from its bony connections with a chisel, leaving it attached to the

flap by its anterior surface ; the cartilaginous septum was then divided from before backwards and downwards with scissors, and left attached by its base to the cutaneous cartilage, that a central support might be provided for the new structure. The whole flap was then drawn downwards, until the upper border of the loosened nasal bone (left) came opposite to the lower border of the right one, when they were fastened together with a metallic suture. The sides of the flap were then united to the cheek, and the frontal incision closed above its apex."

In this case it is said that the space left by the removal of the left nasal bone was filled by bone developed from the periosteum that had been slid down from the forehead.

(B) *Operations for Depressed Nose.*—In these instances the nose is perfectly flat. The integuments are probably sound, and no actual gap or defect marks the surface. The bones and cartilages, however, which support the organ are wanting to a greater or a lesser degree, and the resulting deformity is considerable.

Operative interference in this class of case has been attended with most unsatisfactory and invariably disappointing results.

A simple method recently introduced has given fairly good results. It consists of injecting melted paraffin into the tissues beneath the depression. The paraffin sets, and more or less effectually restores the contour of the nose.

In some examples one of the above complete operations for the formation of a new nose has been carried out. In such instances the scanty tissues of the depressed nose have been made use of to form secondary flaps. The operative measures alluded to in the section on Operations to Prevent Depression of the New Nose (page 22) have been applied in these instances. In Verneuil's method, described below, the use of nasal flaps, aided by a much-modified frontal flap, is the conspicuous element in the operation.

It is at present a matter of question whether in these instances a better result cannot be obtained by the subcutaneous injection of paraffin or by the adjustment of an artificial nose. As the operations in vogue cannot be considered to have been as yet

entirely put aside in favour of non-operative measures, the best known of them is here described.

It is assumed that the tip and alæ of the nose are not wanting.

Verneuil's Operation.—An incision is made vertically along the median line of the depressed organ.

At each end of this—*i.e.* at the root of the nose and just above the alæ—a transverse cut is made. The two nasal flaps thus marked out (Fig. 269) are dissected up. A comparatively small oblong flap is now raised from the middle of the forehead, its pedicle being placed between the two inner canthi.



Fig. 269. —VERNEUIL'S METHOD OF RHINOPLASTY: THE FLAPS IN POSITION.

It is turned downwards—without torsion of the pedicle—so that it closes the large opening made into the nasal fossæ by the dissection of the nasal flaps. The raw surface is anterior or external, the cutaneous surface looks towards the nasal fossæ.

This flap is fixed in position by a few sutures.

The two nasal or lateral flaps are now drawn over it, and are united together in the median line. The wound in the forehead is closed as far as possible by means of sutures and a hare-lip pin, and the granulating surface left is subsequently grafted. The pedicle of the frontal flap will, at a later period, require to be divided and trimmed. In Verneuil's case the new nose thus formed was raised one-third of an inch above the adjoining surface. The scars formed by the lateral incisions fade gradually into the naso-labial sulci and the folds beneath the eye.

Mr. Jacobson speaks well of this operation.

(c) *Operation for Depression of the Nose due to Displacement of the Cartilages from the Nasal Bones.*—This condition will be the result of a well localised injury in which the nose has been “smashed in.”

In these cases Mr. Walsham (*Lancet*, April 4th, 1903) claims to have obtained the happiest results by wiring the cartilages

to the bones. An incision is made exactly in the centre of the nose in a vertical direction, beginning about half an inch above the ends of the bones and continued for half an inch or more over the cartilages. The sides of the skin incision are carefully dissected up from the bones and cartilages for a good half-inch on each side. With a sharp knife the cartilages are next divided transversely along the line of the osteo-cartilaginous junction, avoiding perforation of the mucous membrane. If the cartilages can now be brought up to the level of the bones, well and good; if not, the projecting ends of the bones may be snipped off with fine bone-scissors. The end of each bone is now perforated with a small bone-drill, and a fine silver wire suture is passed through the hole thus made, with a curved needle, which is then made to perforate the corresponding cartilage from within outwards. On twisting the loop the cartilage will be drawn up into place. The opposite side is now treated in the same way, the ends of the wire are securely beaten down, and the external wound is closed with the finest fishing-gut sutures and sealed with a collodion gauze dressing.

PARTIAL RHINOPLASTY.

The operations carried out for the relief of slighter deformities and partial defects of the nose are very numerous, and for the most part consist simply in the application of the common principles of plastic surgery to the part.

1. **Fistulous Openings** of small size, leading into the nasal cavities, may be closed by freshening the edges, by freeing the tissues of the margins, and approximating them by sutures.

Larger openings may be closed by one or other of the methods already described for dealing with defects of various sizes and shapes (page 4 *et seq.*).

2. **Defects in the Central Part of the Nose**—the root and lower third being quite sound—may be remedied by the

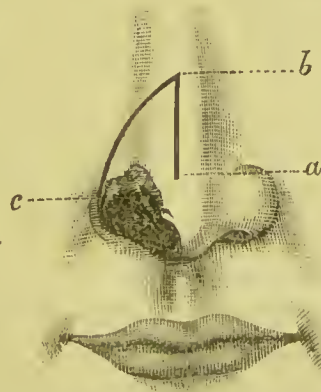


Fig. 270.—DENONVILLIER'S OPERATION.

gliding method (page 4), or by means of definite lateral flaps derived from the tissues of the cheek.

3. **The Formation of a New Ala** may be accomplished in many ways.

(A) *From the Nasal Tissues of the Same Side—Denonvillier's Operation.*—A pedunculated triangular flap is cut from the sound tissues of the nose, just above the defective ala. The pedicle is placed internally at the tip (Fig. 270).

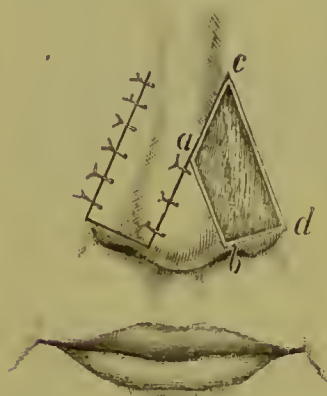


Fig. 271. — LANGENBECK'S
PARTIAL RHINOPLASTY.

The incision is commenced near the tip on the sound side (*a*), and passes upwards (*a b*) nearly to the root of the nose. From the end of this a second cut (*b c*) descends obliquely to terminate at the upper and outer angle of the defect (*c*). This flap is dissected up, and its lower part should contain a strip of undestroyed cartilage. It is finally displaced downwards, and fixed in position by sutures—the margins of the defect having been already freshened to receive it.

(B) *From the Ala of the Opposite Side—Langenbeck's Operation.*—The most convenient shape to give the defect is a quadrilateral one. From the upper and inner angle of the defect an incision (*a b*, Fig. 271) is carried downwards along the dorsum of the nose, nearly to the apex on the sound side. A second incision (*c d*) is made, parallel to the first, and runs from just below the inner canthus to the junction of the ala with the cheek. The lower ends of the two incisions are united by a third cut (*b d*), which runs just along the free border of the ala.

The quadrilateral flap thus marked out is detached from the cartilage as far up as the line of its base (*a c*).

It is then drawn over to the other side, and is fixed by sutures to the freshened margins of the defective area.

It will be observed that a triangular piece of sound skin is left at the tip of the nose.

The defect left upon the sound side should be closed as far

as possible, and should later on be grafted to prevent the contraction which would otherwise be inevitable.

(c) *From the Upper Lip*—Weber's Operation.—The margins of the defective ala having been freshened, an oval flap is cut from the centre of the lip. The pedicle of this flap is attached alone to the columna, while its free margin reaches to the prolabium. Only a part of the thickness of the lip is concerned in the flap.

It is turned upwards, and fixed into position by sutures. At the end of three or four weeks the pedicle is divided, and is applied to the inner surface of the flap, so as to give a thicker and rounder margin to the new ala.

4. The Formation of a New Columna is frequently called for.

(A) The columna may be formed from the tissues of the upper lip, in the manner already described (page 21).

(B) It may be derived from the dorsum of the nose—Hueter's operation.

A quadrilateral flap (*a*, Fig. 272) is taken from the dorsum. The pedicle of the flap is placed near to the tip of the nose, and its free border not far from one inner canthus. The periosteum of the nasal bone is detached with the flap.

The flap is transplanted by twisting the pedicle.

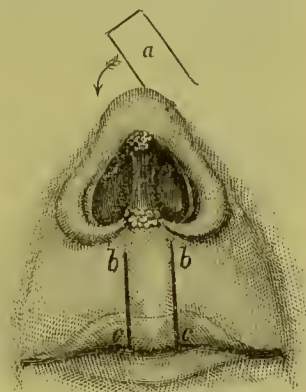


Fig. 272.—FORMATION OF A NEW COLUMNA.

b, c, From the lip; *a*, From the nose. Hueter's operation. (*Löbker*.)

OPERATIONS FOR HARE-LIP.

The Best Time for Operation.—Very different, and to some extent quite irreconcilable, opinions have been expressed upon this matter. The principal point of dispute has been concerned with very early operations—operations undertaken during the first few weeks, or even the first few days, of life.

The weight of evidence and of opinion is, I think, now decidedly opposed to these early operations, and emphatically

opposed to operations undertaken within a few hours or days of birth.

The best period for dealing with a hare-lip would appear to be between the third and the sixth month.

In my own practice I prefer to operate in the later rather than in the earlier part of this period.

It is well that the defect should be dealt with before dentition commences. The first tooth to protrude (the lower central incisor) makes its appearance about the seventh month; the upper incisors are not usually "cut" until the eighth month.

It is desirable, therefore, that the deformity should be dealt with before the seventh month.

Against quite early operations, such as are undertaken during the first or second month of life, the following objections may be urged:—

1. The vitality of the very young infant is low, and the mortality of the first two months of life is remarkably high. During the first four weeks after birth the death-rate is 571·32 per 1,000; during the next four weeks it is 218·37 per 1,000; between two and three months of age it has fallen to 157·10; and at the age of six months the death-rate is represented by 115·09 per 1,000 (Registrar-General's thirty-eighth Report).

2. In the very young infant the parts are small and fragile, are difficult to handle, and are more readily damaged. The tissues, moreover, afford a less firm hold for sutures.

3. The difficulty of feeding is quite unfounded and, such as it is, is soon got over with care and attention, and the risk of malnutrition and wasting, which is stated by some to attend hare-lip, has not been shown to offer a valid reason for early operation. The child who has become wasted has probably been indifferently cared for, or is the subject of some intercurrent disease, and a hasty closure of a cleft in the lip can hardly be expected to remedy the one or to remove the other. The argument that the child has wasted is an argument for postponing rather than for hastening the operation. The marasmic infant is a wretched subject for plastic surgery. If the palate be sound, many children with even severe hare-lip can suck admirably.

In order to ensure the success of the operation, the child should be in good health and its digestive functions in perfect order. It would be calamitous to discover, after the operation, that the infant was the subject of a cough or of severe coryza.

Another element necessary to success is a good nurse.

SINGLE HARE-LIP—THE USUAL OPERATION.

The Form of the Hare-Lip will determine the details of the operation or the method selected. There may be merely a notch in the lip, or the cleft may extend into the nostril, or may end just short of it.

In the most favourable cases the edges of the cleft are equal, are of substantial thickness, and are not widely separated. The majority of the examples of hare-lip may, perhaps, be placed in this category.

In less favourable instances the margins of the split are unequal and widely divergent, and it may be that the tissues of the lip are scanty and adherent. Owing to the septum being turned over to one side, the ala of the nose of the opposite side may be flattened, and the nostril represented by a mere transverse slit.

The complication of cleft palate may exist.

Instruments Required.—A fine, narrow, sharp-pointed scalpel or a small tenotome (for the less simple methods a slender double-edged knife is useful); slender-bladed dissecting forceps with toothed points; small sharp-pointed scissors curved on the flat; straight blunt-pointed scissors; artery forceps; sequester forceps with broad ends protected by indiarubber; needles and sutures; needle-holder; a gag and tongue forceps may occasionally be useful; small fine sponges.

The Operation.—The operation here described is that most usually carried out in Great Britain, and is the method adapted to the majority of the cases of single hare-lip.

The infant is wrapped up in a towel or sheet, so that the head alone projects. In this mummy-like guise it is easily handled, and the movements of its limbs are restrained.

The patient lies supine, with the head well raised and supported upon a sand-bag or firm cushion.

The surgeon faces the patient, or stands to the right-hand side. An assistant places himself behind the child, and steadies the head, while at the same time he compresses the facial arteries against the lower jaw. The administrator of chloroform will stand upon the left of the table.

First Step.—Grasping the upper lip, the surgeon proceeds to separate it—upon each side of the gap—from the maxilla. This can best be effected by means of small sharp-pointed scissors curved on the flat. The scissors must be kept close to the bone. It may be necessary to detach one ala of the nose from the maxilla. In any case the detachment should be sufficiently free to allow of the margins of the cleft coming together readily and without the least tension.



Fig. 273. — OPERATION FOR SINGLE HARE-LIP.

If the maxilla of one side project inconveniently beyond its fellow, it should be forcibly bent back with sequestrum forceps, the blades of which are protected by india-rubber. “The bone,” writes Mr. Jacobson, “should be felt to crack when this is done, otherwise, if merely bent back, it springs forward again, and causes tension of the flaps.”

Second Step.—The edges of the cleft are pared. The lower angle of one flap of the lip is seized with fine-toothed dissecting forceps, is drawn upon, and the margin is then pared with the narrow scalpel. The incision for paring the edge should commence above, at the upper angle of the gap, and descending obliquely, should curve inwards, when the red margin or lower angle of the flap is nearly reached (Fig. 273).

When one side has been treated, the other is dealt with.

Or the lip on one side having been made tense, it may be transfixed in its whole thickness from before backwards by the narrow scalpel. The point is entered just above the lower angle of the flap, and, the edge being directed upwards, the knife is made to cut towards the upper angle of the gap, to follow that angle, and finally to descend upon the other side. The knife is then withdrawn, and is not allowed to cut its way out.

The piece isolated by paring will still be attached to the lip at both ends, and its detachment may be left until some of the sutures have been introduced, and until the amount of tissue required for the formation of a good free margin to the new lip has been ascertained.

In any case the paring must be freely, liberally, and evenly carried out. The raw surface should be as wide as possible, especially below.

During this step there may be much bleeding, which must be checked either by pressure upon the facial arteries, or by the compression of each coronary artery at the angle of the mouth between the thumb and finger of an assistant. The latter procedure is the more efficacious, but the operation area is encroached upon and disturbed, and in the place of an assistant's fingers some form of hare-lip compression forceps may be used.

Third Step.—The gap is now closed. The assistant who holds the head presses the cheeks together with his fingers, so that the two raw surfaces are approximated. The approximation must be exact. The margins are then united by means of fine silkworm-gut sutures carried on straight needles.

The first suture should involve the middle of the lip, the next the lower portion, and the third the segment near the nostril. These are the three main sutures. They should include the whole thickness of the lip, excluding the mucous membrane only; and the first or median suture, if properly introduced, should command the coronary arteries when it is finally drawn tight.

It is well to pass the three needles one after the other, and to leave them in the tissues until it has been ascertained that the best possible approximation of the raw edges has been obtained. From the manner in which the cheeks are held, the relations between the two sides of the cleft may be disturbed. The three needles act as three temporary pins.

After the surgeon is satisfied that the best possible adjustment has been obtained (and one or more of the needles may have to be re-introduced before it is obtained), the sutures are

drawn through, tied in the usual way (page 50, vol. i.), and cut moderately short.

The three stiches are introduced about one-third of an inch from each side of the cleft.

Two, three, or more sutures are now inserted at the free margin of the new lip, especially upon its inner or alveolar aspect. These are composed of the finest silk, and are passed by means of slender curved needles held in a needle-holder.

Some of these fine stiches may be required along the main wound, and one will usually be needed for the margin of the nostril.

So-called hare-lip pins are never required, nor is strapping ever needed to support the wound.

Dressing and After-treatment.—The wound having been well dried with small pieces of fine sponge, the surface is dusted with boracic acid or iodoform, and is covered with a strip of soft gauze. The gauze may consist of several layers, and the component strip must be cut to exactly fit the part, and should not extend on to the cheek. A very slender piece of strapping will keep the gauze in place. Instead of plain gauze, gauze or collodion, or a solution of celloidin (5 parts) in ethylic alcohol and ether (of each 10 parts), may be used. The latter dressing fits accurately, and is not irritating.

In the nursing of the case every care must be taken to keep the area of the wound as dry as possible, to keep the nostrils free from mucus so far as can be managed, and so to feed the patient that no strain falls upon the wound.

Young infants can be kept perfectly quiet for many days after the operation by the administration of repeated minute doses of chloral. Children so treated remain remarkably still, do not cry, and appear not to suffer the least harm from the use of the drug. In my own cases it is given regularly, and I have never seen anything but good result from its employment.

In patients a little older than the average of those who are subjected to this operation, steps must be taken to prevent the child from meddling with the dressing.

The wound should be inspected if there be any suspicion that it has become soiled.

As a rule no suture need be removed until the seventh or eighth day. They may be removed on successive days.

At a later period a further plastic operation may be needed to improve the appearance of the parts, and especially to remove any notching which may occur at the free margin of the new lip.

Should the wound break down, the case should not be regarded as hopeless. The raw edges should still be kept approximated, and every assistance given to the process of granulation.

Comment.—The operation cannot be so well carried out, nor can the head be kept so steady, if the infant be held in the nurse's lap, as is not unfrequently advised.

It is most essential that the lip should be well freed on both sides of the gap. If this be effectually done, there is no tension put upon the wound, and even in quite large clefts the pared margins are brought readily into contact.

The paring should be accomplished with a knife, and not with scissors.

The recommendation that as little as possible should be cut away is not one that should be followed. In paring the edges there must be no stinting. The fault of the young operator consists usually in removing too little rather than too much.

If the lips are pared as advised—the incisions terminating abruptly below—there is little risk of a notch forming when the scar contracts. The possibility of such notching has been urged as an objection to this operation.

Fenestrated artery forceps are not well adapted for seizing the margins of the flaps. The forceps used should have no "catch."

Some surgeons use silver wire for the median suture (*i.e.* the suture which commands the coronary arteries), employing gut or horsehair or silk for the other stitches.

Hainsby's truss is a very ingenious contrivance, but it cannot claim to be of practical value. It is better dispensed with.

Louis's bandage is still employed by some surgeons to support the tissues of the lip and to keep the cheeks pressed a little forwards. Mr. Mason describes it as follows:—A double-headed

roller, less than an inch in width, and a yard and a half long, is placed with its centre over the middle of the forehead, and the two ends are then carried behind the head over the ears to the occiput, where they are made to cross and are brought forward again.

Two slits are now made in one end, while the other end is divided into two tails. The two tails are passed through the two slits, and then, by making traction upon the ends of the bandage so treated, the edges of the lip are brought together. The ends are carried back again to the nape of the neck, and there fastened. The bandage is of doubtful advantage.

Mr. Jacobson calls attention to the fact ("Operations of Surgery," 1902, vol. i., page 410) that "in some cases of hare-lip death from dyspnœa may take place very soon after the operation. Thus, where the cleft has been a large one, and the upper lip when restored is tight, when it overhangs the lower, if the nostrils are flattened and partially closed by the operation, owing to the tension of the parts, so little breathing-space may be left that temporary interference with respiration may occur, with grave and even fatal results before the breathing can be accommodated to the altered circumstances, and before the parts dilate and stretch."

OTHER OPERATIONS FOR SINGLE HARE-LIP.

Nélaton's Operation.—When there is only a slight notch in the lip, as shown in Fig. 274, this operation is very useful.



Fig. 274.—NÉLATON'S OPERATION.

Such a notch may be due to congenital defect, or may more frequently depend upon undue contraction at the site of a previous operation for hare-lip.

The notch is circumscribed by a V-shaped incision, which does not, however, involve the border of the lip. With fine-pointed forceps the piece so isolated is drawn downwards, so

that a diamond-shaped wound is produced. The opposite sides of the wound are united by sutures (Fig. 274).

The slight projection which is left at the edge of the lip will shrink and disappear in the course of time.

Malgaigne's or Clemot's Operation.—In single hare-lip of moderate degree, in which the margins of the cleft are equal, or nearly so, and in which there is but little divergence, this method is advised by some in the place of the usual operation.

It is claimed for it that the possibility of a notch being left at the edge of the lip is removed.

The edges of the cleft are freshened by detaching a flap on either side. Each flap is attached below, but free above, and they meet at the upper angle of the cleft.

The manner in which these flaps are cut is illustrated by the lateral flaps shown in Fig. 280.

These flaps are seized with toothed forceps, are drawn downwards, and are kept out of the cleft (Fig. 275). The upper part of the cleft is then united by sutures, while the projecting portions of the flaps are shortened to the extent required, and are then joined together by a few fine stitches (Fig. 275).

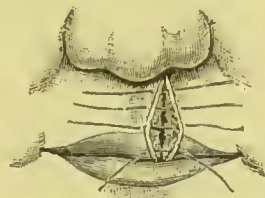


Fig. 275.—MALGAIGNE'S OPERATION.

In the place of a notch a considerable prominence is left on the margin of the lip, and this may need a little paring down if it persists at the end of six months.

If the margins of the cleft are unequal, as is so commonly the case, a perfect apposition of the wound is very difficult when this method is carried out.

Mr. Jacobson also notes that “unless great care is taken, a little skin, imperceptible at first, but showing white after a time, may remain below the red line, or as a break in it.”

Mirault's Operation.—When the edges of the flap are very unsymmetrical, and when they diverge considerably, the following operation gives admirable results:—

A flap is cut from the shorter or more vertical margin of the cleft. It is free above, and is attached below near to the red border of the lip (Fig. 276, a). It is most conveniently

fashioned by transfixing the lip just above this border, and by allowing the knife to cut its way out at the upper angle of the cleft. This flap must be composed of the entire thickness of the lip, must be large and substantial, and not a mere paring



Fig. 276.—MIRAULT'S OPERATION.

from the edge of the cleft.

The longer or more oblique margin of the gap is now freshened by paring, and care must be

taken that the raw surface is as wide as possible.

The flap is now drawn down and placed in position, and the wound closed by sutures (Fig. 276).

In this operation it is especially important that the separation of the lip, which has already been insisted upon (page 38), should be very freely carried out. It may be necessary to detach one or both alæ. The edges of the gap must be approximated without tension. A common fault in this procedure consists in making the flap too small and scanty.

Giraldès' Operation.—This is adapted for severe forms of single hare-lip, where the margins are very unequal and divergent, and especially where the cleft enters by a large gap into the nostril.

The tissues on each side of the cleft must be well and extensively freed from the maxilla. From the shorter and less



Fig. 277.—GIRALDÈS' OPERATION.

oblique margin of the cleft a flap (Fig. 277, *a*) is cut, as in Mirault's operation. From the upper end of the incision terminating this flap a second cut (*b*) is carried outwards, just below the border of the nasal aperture.

From the more oblique or longer side of the cleft another flap is fashioned with its apex or free end (*c*) downwards. The first flap (*a*) is drawn downwards, and forms the new margin

of the lip. The other flap is drawn upwards, so that its apex (*c*) is fixed to the extremity of the incision (*b*), and this strip of tissue serves to form the lower boundary of the new nostril.

The somewhat complicated wound produced by the transposition of these flaps is closed by sutures, and the flaps themselves are securely fixed in place.

Hagedorn's Operation.—With a sharp-pointed knife the incision 3-4-2 (Fig. 278) is made on the lateral side of the cleft, and the incision 4-3-2 on the median margin. Finally, with a pair of sharp scissors, the incisions 5-1-4 are made upon each side of the defect. The margins of the gap thus isolated are removed, *i.e.* the whole of the margin from 5 to 2. The raw

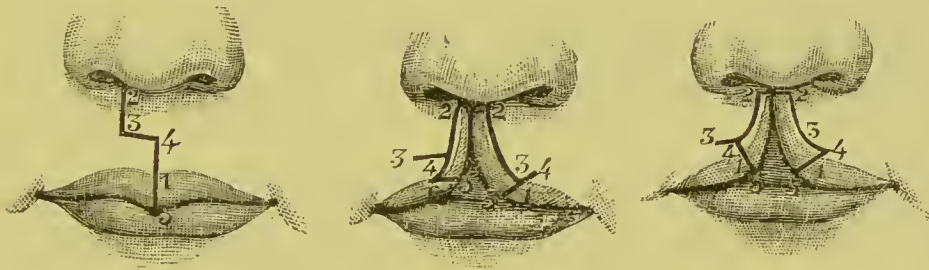


Fig. 278.—HAGEDORN'S OPERATION.

surfaces are then adjusted as shown in the left-hand diagram in Fig. 278. By this it will be seen that the points which were before on each side of the cleft, and which are indicated by corresponding figures, are brought together—*i.e.* the point marked 3 on the right side is united to the point marked 3 on the left side, and so on. Or the incisions may be disposed as shown in the right-hand side diagram in Fig. 278, the points upon each side of the cleft, which are indicated by corresponding figures, being brought together.

DOUBLE HARE-LIP.

The operation required in cases of double hare-lip is of the same character as that already described.

In many instances the defect is more easily remedied when it is double than when merely a single gap exists. In the most favourable forms of double hare-lip the sides of the cleft are

symmetrical, and are, moreover, more nearly parallel than is the case in single hare-lip.

A misplaced pre-maxillary bone is the most troublesome complication met with in dealing with this deformity.

Form of the Hare-Lip.—From the point of view of operation, Sir T. Smith (*Lancet*, 1867, vol. ii.) divides double hare-lip into the three following varieties :—

1. When the pre-maxillary bone is *in situ*, and the two elefts are simple and fairly bilateral.

2. When the pre-maxillary bone is separated from the rest of the jaw, and projects forwards, in some cases slightly, in others being attached to the vomer, and hanging from the tip of the nose.

3. When the pre-maxillary bone is small and ill-developed, and when the elefts are widely gaping.

The following are the operations adapted for the three varieties :—

First Variety.—In this simple form the skin over the pre-maxillary bone is freed from its deep attachments behind, and its edges are pared so that it receives a U- or V-shaped outline. The margins of the lip on each side are then pared in the manner already described (page 38). The portions of the lip may or may not need to be freed from their attachments (Fig. 279). The raw edges are finally united with silkworm-gut sutures. Owing to the small size and



Fig. 279.—OPERATION FOR DOUBLE HARE-LIP.

the shape of the central piece, the resulting wound is more or less Y-shaped.

In order to avoid the notching which not unfrequently occurs in the median line, when cicatrisation has taken place after this operation, thick flaps with square ends may be cut from each margin of the main eleft, as shown in Fig. 280. These flaps have their attached ends downwards. They are united to the raw margins of the central segment above, and to one another along, what is now the new margin of the lip. The

segments of the lip will need to be freed from their deep connections on each side of the cleft.

Hagedorn's Modification of the usual operation is illustrated in Fig. 281, and can be best understood by a study of the diagram. The soft parts covering the pre-maxillary bone are pared liberally. The raw margin produced is bounded by the incision 4-a-1-o-4.

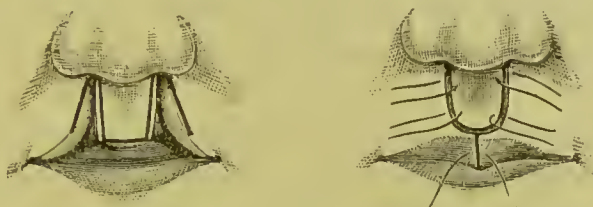


Fig. 280.—OPERATION FOR DOUBLE HARE-LIP.

The margins of the cleft are pared in the manner shown. The part actually removed in the freshening process is left unshaded in the diagram, and is bounded by the incision 4-2-3. The lateral cuts $a'1$ and $o'1'$ are nearly parallel with the free margin of the lip.

The raw edges are united in such a way that points marked in the figure by corresponding numbers are brought together by sutures (Fig. 281).

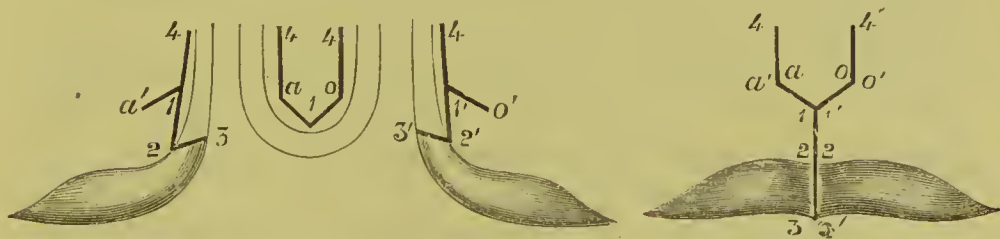


Fig. 281.—HAGEDORN'S OPERATION FOR DOUBLE HARE-LIP.

Second Variety.—In this variety the projecting pre-maxillary bone offers a serious obstacle to the proper closure of the cleft by operation.

Many very different plans have been proposed for dealing with this unfortunately-placed piece of bone.

It is needless to consider these various methods in detail: many are obsolete, many differ from one another in but the most insignificant feature.

The experience of the past and the expressed opinion of

most living authors are practically unanimous upon one point, viz. that the pre-maxillary bone should be preserved whenever possible, and that its excision is a procedure to be condemned. If this little piece of bone be removed, a permanent gap is left in the hard palate, the upper lip tends to become flattened, malplaced, and unsightly, and is liable to be retracted on inspiration. The patient loses a point which might prove useful in supporting false teeth. There occurs in time a want of correspondence between the upper and lower dental arches, and the patient is said to be "under-hung."

The following courses might be recommended in dealing with this bone:—

(a) In the simplest cases the pre-maxillary bone may be forced back into line with the rest of the jaw. This may be done either with the thumbs or by using necrosis forceps with smooth blades protected by india-rubber.

This fracture can be effected when the attachment of the os incisivum is slender, and when there is room between the maxillæ to receive the displaced fragment.

If it tends to protrude after such fracture, the bone may be held in place by catgut sutures attached to the upper jaw.

If the maxillæ offer no space to receive the fractured fragment, a bed for the bone may be made by removing small portions of the maxillæ with the chisel, and then fixing the fragment in position with sutures.

(b) Very usually the bending back of the bone is resisted by the cartilaginous vomer of children, and the elasticity of that structure causes the fragment to be again protruded when the pressure is removed.

In such a case a portion of the vomer may be excised subperiosteally, as advised by Bardeleben, Guérin, and others. An incision is made along the free border of the septum, leaving its arteries intact: the periosteum and mucous membrane are then elevated on either side, and a triangular segment is excised from the vomer. The os incisivum may now be pushed into place, and may be retained, if needed, by one or more sutures.

The bleeding in this operation is apt to be free, unless the subperiosteal method be closely adhered to.

(c) Should a case occur in which by no method yet named the little bone can be reduced, then the mucous membrane covering it may be incised, and the main part of the bone, together with the temporary incisors, scooped out with a gouge. After such a measure, which was advised by Sir William Fergusson, little but periosteum and a thin plate of bone would remain.

The method described under (b) is the best one to adopt in most cases, and has given excellent results in our experience.

After the reduction of the bone, the gap is closed by one of the methods already advised.

Third Variety.—In the last of the three varieties named, the two margins of the lip have merely to be brought together and united to one another and to any portion of the central segment which may be available. To effect this, an extensive separation of the lip, and possibly of the cheek, on either side, will have to be carried out, for until the soft parts have been well freed from the underlying bones, no approximation is possible.

It is in these cases that the use of the fine steel hare-lip pins may be of service, and in any instance the lip must be well supported, and the cheeks kept pressed forward. Louis's bandage (page 41) may serve to effect these ends.

An excellent series of woodcuts, illustrating almost every known form of operation upon hare-lip, will be found in Gerhardt's *Chirurg. Erkrank. des Kindesalters*, vol. ii., page 132, Tübingen, 1889.

CHAPTER IV.

PLASTIC OPERATIONS TO REMEDY CERTAIN DEFECTS OF THE LIPS.

THE defects here dealt with are, for the most part, such as result from the removal of epitheliomatous growths by operation, and losses of tissue due to destructive ulceration, to lupus, to burns, and to injuries, and notably to gunshot wounds.

The defects will be mostly of triangular or quadrilateral outline.

The operations proposed, or actually carried out, in these cases are very numerous, and, in many instances, very complex. No one operation, nor even one method of operating, can meet the requirements of every case. Every individual example must be taken upon its merits, and much must be left to the judgment and ingenuity of the operator.

A very large number of methods for restoring the lips are depicted in Serre's Atlas (*Traité sur l'Art de Restaurer les Difformités de la Face*, Montpellier, 1842), and also in Szymanowski's *Handbuch der operativen Chirurgie*, 1870. Dr. Buck's work upon the subject is described in his "Contributions to Reparative Surgery," New York, 1876. In the following account of the most usual operations, I have drawn largely upon the excellent description of cheiloplastic methods given in Karl Löbker's *Chirurgische Operationslehre* (Wien, 1885).

General Observations.—In all these operations great care must be bestowed upon the sutures, and especially upon those which fix the new margin of the lip. The sutures should include all the tissues except the mucous membrane.

A few fine silk sutures involving the mucous membrane only may be inserted along the free margin of the lip. The

best material for the main stitches is silkworm-gut. Hare-lip pins are rarely required. They must be fine, and made of good steel, so that they cannot be bent out of a straight line. The thread fixing the pin should be of silk applied in a figure of 8, and as short a length as possible should be applied. The great mass of silk ligature sometimes twisted about hare-lip pins is capable of producing some sloughing from pressure, and of interfering with the healing of the wound at the most important part.

Hare-lip pins should be avoided whenever possible, and if the tissues upon each side of the gap to be closed are well freed their employment may be less often imperative.

A large proportion of these operations are performed upon old persons, in whom the tissues are lax and extensible.

The bleeding during the operation is arrested by compressing the coronary arteries, which is done either by the finger and thumb of an assistant or by special forceps or clamps.

One of the sutures or one hare-lip pin must be so introduced as to command the coronary arteries when the wound is adjusted.

Any carious teeth in the jaw, and especially diseased incisors, should be removed before the operation, and the mouth placed in as healthy a condition as possible.

In adult males the parts must be carefully shaved.

A dry dressing of the simplest character should be employed. Powdered boracic acid, and a little dry sterilised gauze kept in place by collodion or celloidin solution (in alcohol and ether), answer well.

Hare-lip pins should be removed on the third day, if not before.

It is important that the mouth be kept well and frequently washed out. Discharge—which the patient has no power to expel—is apt to accumulate between the cheeks and the lower jaw, and behind the lower lip. It is retained, and decomposes. The mouth should be frequently flushed out with an irrigator, and still more frequently rinsed out by the patient. One of the best solutions, both for the irrigator and as a mouth-wash, is a one in sixty or a one in eighty solution of carbolic acid.

THE LOWER LIP.

1. **The Closure of Wedge-shaped Defects by the Method of Gliding or Lateral Displacement.**—So long as the base of the triangular defect is less than half the normal width of the lip, the surgeon may bring the edges of the freshened wound together and unite them by sutures. Even if the defect involve more than half the width of the lip, direct union by sutures may often be carried out, especially in old subjects with relaxed tissues and possibly edentulous jaws. If the defect be median, no loss of symmetry will be observed; but if—as is often the case—one lateral portion of the lip be involved more than the other, then some traction upon one corner of the mouth will follow, and the aperture will tend to become rounded on the affected side. The form of the mouth may be left considerably distorted, and the aperture be too small.

It is assumed that in the adult the normal oral aperture should admit three fingers placed side by side.

In such cases the *Method of Hueter* may be carried out. After the margins of the defect have been brought together, or the large growth excised, an incision is made in the cheek, starting from the oral angle and directed horizontally outwards. This cut involves the whole thickness of the cheek upon the distorted side. The mucous membrane upon each side of this new wound is reflected a little, and is then united to the skin by sutures, so that the raw surfaces are covered. In order that the new angle of the mouth should also be lined by mucous membrane, an oblique incision running upwards and outwards is made in that membrane, and the little triangular flap thus marked out is drawn into the angular recess and secured there.

The entire incision in the mucous membrane will therefore have the outline of the letter < placed horizontally.

This procedure is very similar to that known by French surgeons as *Serre's Method*.

In dealing with defects of considerable size and of triangular outline, one or other of the methods of gliding already described (page 4) may be employed. In the lower lip, the

most convenient operation among these is that known as *Jaesche's*. (See page 5.)

In the case of a large median defect the incisions made would be symmetrical, *i.e.* a curved incision, starting from the angle of the mouth and ending at the lower border of the jaw, would be made upon either side. The flaps thus marked out would be joined in the median line after they had been well freed from the parts beneath.

2. The Closure of Quadrilateral Defects, and the Restoration of the Lower Lip by means of Flaps.

(A) *Langenbeck's Operation*.—The lower horizontal margin of the defect is prolonged on either side by incisions, which pass along the remainder of the lower lip, round the angles of the mouth, and

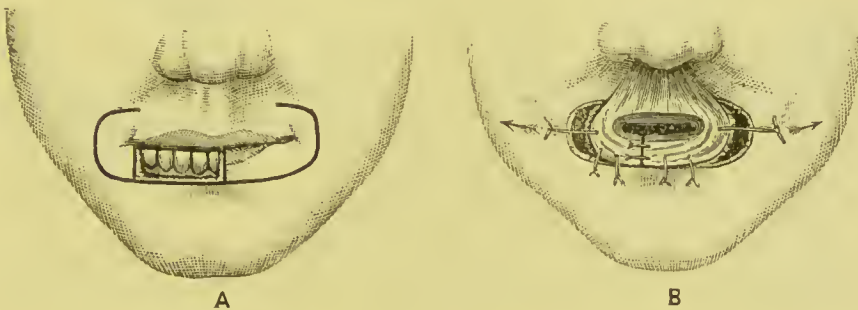


Fig. 282.—RESTORATION OF THE LOWER LIP : LANGENBECK'S OPERATION.
(After Löbker.)

into the upper lip, in the manner shown in Fig. 282, A. The broader the defect to be closed in, the nearer must the incisions approach the median segment of the upper lip.

This segment, however, must always be left intact, so that the communications between the coronary vessels and the arteries of the septum may not be disturbed.

The portions of the lips thus marked out are mobilised, and are drawn together towards the symphysis of the lower jaw, and are there united by sutures. Sutures must always be placed at the new angles of the mouth, in order to preserve the normal outlines. The rest of the wound is finally closed (Fig. 282, B).

This method is not adapted for cases in which the loss of substance extends downwards beyond the movable part of the lower lip. In such instances it would be impossible to detach the upper lip sufficiently, and even if that could be carried out the oral aperture would be too small.

(B) *Estlander's Operation*.—This method may be employed

when the loss of substance in the lip is partial, and on one side, and when the defect extends downwards to the skin over the chin,

A triangular flap is so fashioned from the upper lip that its pedicle or base contains the coronary artery, while its apex is situated on the cheek (Fig. 283, A).



Fig. 283.—RESTORATION OF THE LOWER LIP: ESTHLANDER'S OPERATION.
(After Löbker.)

This flap is then turned downwards, so that its apex comes to occupy the lower angle of the defect.

It is here fixed by sutures. The gap left in the upper lip is closed by suitable stitches (Fig. 283, B).

Both in this and in the preceding measure a lining of mucous membrane is obtained for the new lip edge.

(c) *Bruns' Operation*.—Bruns' method may be carried out when the whole breadth of the lower lip has to be restored, as shown in Fig. 284.



Fig. 284.—RESTORATION OF THE LOWER LIP: BRUNS' OPERATION. (After Löbker.)

Here two quadrilateral flaps are fashioned out of the whole thickness of the cheek and upper lip, and are placed one on each side of the mouth.

They will receive a liberal blood supply from the facial arteries. After having been mobilised, they are so turned downwards that their upper borders can be sutured together in the median line.

It may be possible to adjust the mucous membrane lining these flaps in such a way as to provide a mucous covering for the margin of the new lip (Fig. 284).

The wounds on the cheeks are finally closed by sutures.

(D) *Operations by Flaps derived from the Chin.*—When the tissues of the cheek or of the upper lip are unsuited or unavailable for flap formation, use may be made of the integuments of the chin.

The skin of this part is well adapted to form a sound flap, but in these operations a lining of mucous membrane is wanting in the flap, and consequently must be lacking—in the first instance at least—in the new lip. The flap may be single or double.

1. *Langenbeck's Method by Single Flap.*—One of the margins of the defect is cut obliquely, and is prolonged downwards as an incision through the tissues covering the chin. Its length must depend upon the size of the deficiency in the lip.

Between this incision and the lower border of the defect a triangular piece of skin remains, which serves subsequently to



Fig. 285.—RESTORATION OF THE LOWER LIP: LANGENBECK'S OPERATION.
(After Löbker.)

support the flap. By means of two other incisions, which meet at right angles, a flap is formed with its base or pedicle upwards and outwards (Fig. 285). This flap is detached, is displaced upwards, and is secured in place by sutures. The wound in the chin is closed in like manner.

2. *The Method of Syme and Buchanan by Double Flaps.*—Each flap is made to correspond to one-half of the new lip, and is formed by prolonging the edges of the defect downwards by two incisions which meet and cross obliquely (abc' , $a'bc$, Fig. 286). Their length will depend upon the size of the gap to be closed after due allowance has been made for shrinking. From their lower ends two other incisions are made at right angles (bc , $b'c'$, Fig. 286), and the flaps are completed by two final incisions, cd , $c'd'$. These flaps are liberated, and are turned upwards, so that they may be united in the median line along the lines bc , $b'c'$. The broad support for the flap which is provided by Langenbeck's method is wanting in this operation. Two small triangular raw surfaces may be left below, and will be allowed to close by

granulation. The central and prominent part of the chin is left undisturbed.

Only in extreme cases is it advisable to make use of the skin below the chin, or that of the neck, in forming a new lip. In some cases of extensive epithelioma of the lower lip, in which it is impossible to save any of the latter, and in which the submaxillary lymphatic glands require excision, the following procedure should be carried out:—

The growth is removed by two converging incisions, which meet above the prominence of the chin. From this point the



Fig. 286.—RESTORATION OF THE LOWER LIP: SYME AND BUCHANAN'S OPERATION. (After Löbker.)

knife sweeps downwards on either side of the middle line, curving below the submaxillary glands. The flaps are then raised and all suspicious lymphatic glands dissected out (it may be sometimes advisable to remove the salivary glands as well, the facial vessels being ligatured). From each angle

of the mouth two lateral incisions are now made passing outwards and downwards into the cheek, and thus the broad flaps can be freed, so that their inner edges can be sutured together in the middle line. A certain amount of puckering of the cheek must result, but it can be improved by excision of small wedge-shaped portions, and a good ultimate result obtained.

THE UPPER LIP.

Plastic operations are less frequently called for in the upper lip than in the lower.

Defects of small size may be closed by certain of the general methods already described (page 3), and in a few instances by operations akin to those above detailed, as performed upon the lower lip (page 52). The following special operations represent the most typical of the very numerous plastic measures which have been advised or carried out in this part.

1. For Partial Defects.

(A) *The Central Part of the Lip is Deficient.*—*Dieffenbach's Operation.*—The central part of the upper lip may be deficient, and an obtuse-angled triangular defect exist, with its apex below the nose, and with its edges covered with mucous membrane.

Two curved incisions start from the apex of the defect, and are carried round the alæ of the nose in the manner shown in Fig. 287. These incisions, together with the margins of the defect, mark out two flaps.

These are detached from the subjacent parts, and are brought together in the median line (Fig. 287). The mucous membrane, which marked the borders of the defect, is preserved, and serves to form the free margin of the new lip.

(B) *One Side of the Lip is Deficient.*—*Buck's Operation.*—In the case cited one-half of the upper lip and a portion of the cheek had been lost.

The lower lip is divided where it joins the cheek by a vertical cut (*a b*, Fig. 288) at right angles to the margin of the lip, and one inch in length.

A second cut (*b c*), about one inch and a half long, starts from the lower end of the first incision, and runs forwards parallel to the margin of the lip. An oblique incision (half an inch in length, *c d*) runs upwards from the second incision nearly to the lip. The attachment of the flap is at this point, and therefore the cut *c d* must not approach too close to the lip.

The edges of the defect are now pared, and the sound part of the upper lip freely detached from the bone beneath. The lower-lip flap is then twisted upwards, and

its upper extremity is connected by sutures with the freshened edge of the upper lip.

The gap left by the removal of the flap is closed by sutures.



Fig. 287.—RESTORATION OF THE UPPER LIP: DIEFFENBACH'S OPERATION.



Fig. 288.—BUCK'S OPERATION FOR RESTORATION OF THE UPPER LIP. (Buck.)

The result of the operation in Buck's reported case is shown in Fig. 289.

(c) *The Angle of the Mouth is Deformed or Contracted.*—*Buck's Operation.*—In the preceding case the mouth was left contracted,

and the commissure of circular outline. Such a result may follow upon destructive disease or burn.

Buck's method in such cases is as follows:—

An incision (*a b*, Fig. 289) is made along the red border of the lip, and extends an equal distance into both the upper and the lower lips, skirting the deformed angle.

This cut involves the skin only, not the mucous membrane. A sharp-pointed double-edged knife is inserted at the middle of the curved incision, and is directed flatwise towards the cheek between the skin and the mucous membrane, so as to separate them from each other, as far as the new angle of the



Fig. 289.—BUCK'S OPERATION FOR RESTORATION OF THE ANGLE OF THE MOUTH. (Buck.)

mouth requires to be extended.

The skin alone is next divided outwards on a line with the commissure of the mouth (*d c*).

The underlying mucous membrane is now divided in the same line, but not so far outwards. The angles at the outer ends of the two incisions are accurately united by fine sutures. The freshly-cut edges of skin and mucous membrane, above and below, that are to form the new lip-borders, are shaped by paring (first the skin and then the mucous membrane) in such a manner that the latter

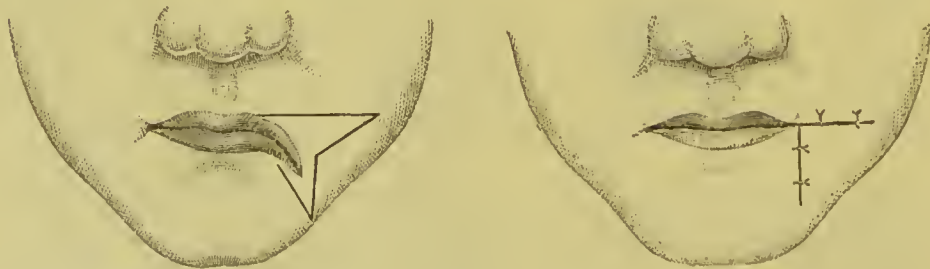


Fig. 290.—SERRE'S OPERATION FOR RESTORATION OF THE ANGLE OF THE MOUTH.

shall overlap the former, after they have been united by fine sutures.

Serre's Operation.—The angle of the mouth is distorted by cicatricial contraction, or is occupied by a growth.

Incisions are so made (Fig. 290) as to mark out two triangles, which meet by their bases at the site of the new angle of the mouth.

When the tissues thus circumscribed have been excised the edges of the wounds are united as shown in Fig. 290. The adjacent

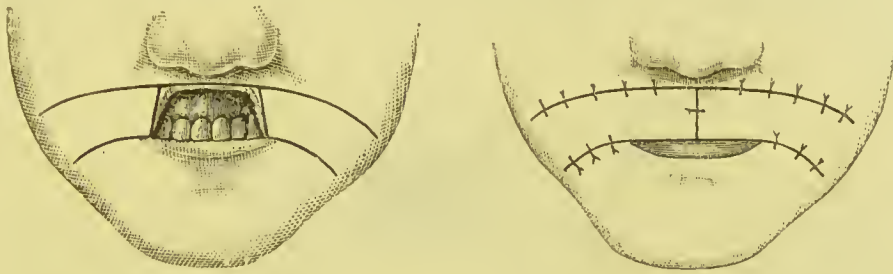


Fig. 291.—RESTORATION OF THE UPPER LIP : SZYMANOWSKI'S OPERATION.

integuments are drawn together, a vertical and a transverse incision resulting.

2. The Whole of the Upper Lip requires to be Restored.

(A) *Operation by Lateral Flaps (Szymanowski's Method).*—Lateral flaps of the full breadth of the lip are cut from the cheek on each side. Their outer extremities are curved downwards, so as to relieve them from tension. After they have been detached their inner extremities are brought together, and united in the median line (Fig. 291).

(B) *Operation by Vertical Flaps (Sédillot's Method).*—Flaps of quadrilateral outline are raised by the use of the following incisions :—An internal one (*a b*, Fig. 292) starts from a point midway

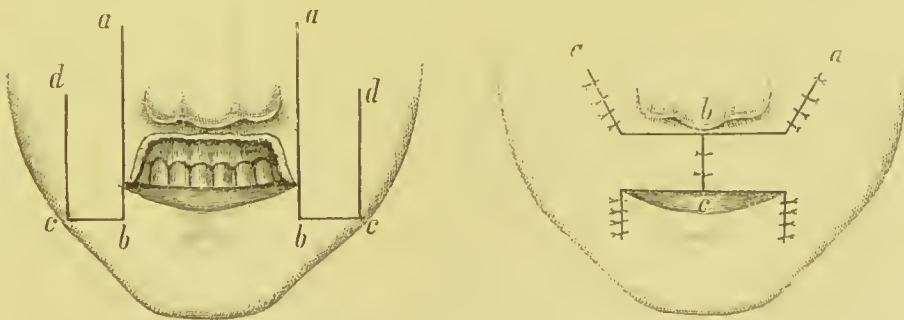


Fig. 292.—RESTORATION OF THE UPPER LIP : SÉDILLOT'S OPERATION.

between the angle of the mouth and the lower eyelid, and ends a little above the prominence of the chin. An inferior horizontal incision (*b c*) passes outwards from the lower end of the internal

incision for a distance of about one inch and a half. An external incision (*c d*) runs upwards from the outer end of the last wound to a point on a level with the ala of the nose. The two flaps comprise the whole thickness of the cheeks, and after detachment are displaced inwards, so that their lower extremities (*b c*) meet in the median line (Fig. 292).

(c) *Dieffenbach's Method*.—In this operation the flaps have their free ends directed upwards instead of downwards. A vertical

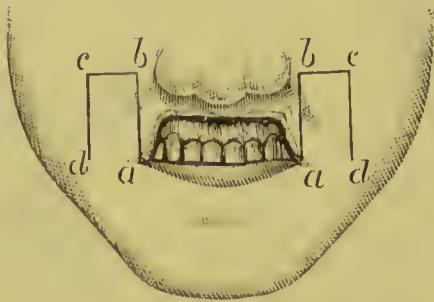


Fig. 293.—RESTORATION OF THE UPPER LIP: DIEFFENBACH'S OPERATION.

incision (*a b*, Fig. 293) is made upwards from the angle of the mouth to a point above the level of the nostril; then a horizontal cut (*b c*) extends outwards more than equal in width to the defect to be remedied. The quadrilateral flap is completed by a vertical incision (*c d*) parallel to the first and ending beyond the angle of the mouth.

The flaps are detached, and are united by their upper extremities (*b c*) in the median line, after the manner of the previous operation.

CHAPTER V.

OPERATIONS FOR CLEFT PALATE.

THESE operations are among the most brilliant of those which belong to plastic surgery. They are concerned with the closure of clefts of all kinds in the palate, but are for the most part limited to the congenital cleft. Perforations in the palate, when due to disease, are usually dependent upon syphilis, and are not suited for operation unless the health of the patient be sound at the time. In selected cases large defects in the soft palate, due to syphilis, may be closed, and the same may be said of small perforations of the hard palate. Large clefts in the hard palate in syphilitic subjects are not well adapted for operation, and are usually best treated by the introduction of an obturator. In any case, it is well that an anti-syphilitic treatment be carried out for some little time before the operation.

The term *staphyloraphy* is applied to the operations upon the soft palate ; the term *uranoplasty* to those upon the hard palate.

History of the Operation.—The operation of staphyloraphy appears to have been first performed by Le Monnier. The case is thus described by Robert, in his *Mémoires sur Différents Objets de Médecine* (Paris, 1764) :—“ A child had the palate cleft from the velum to the incisor teeth. M. Le Monnier, a clever dentist, attempted, with success, to re-unite the two edges of the cleft, first making several points of suture to hold them together, and then refreshing them with a cutting instrument. Inflammation ensued, terminated in suppuration, and was followed by union of the two lips of the artificial wound. The child was perfectly cured.”

The modern operation, as now practised, was gradually evolved by Graefe, Roux, Dieffenbach, and others during the early years of the nineteenth century.

With regard to uranoplasty, the operative treatment of clefts in the hard palate is of much later date.

Dr. John Mettauer (*American Journal of Medical Sciences*, 1837) attempted to close clefts in the hard palate by what was termed the granulation process. Several incisions were made, and the separation of flaps was foreshadowed. Dr. Mason Warren (*American Journal of Medical Sciences*, 1848), however, was the originator of the method of closing these clefts by flaps composed of the soft parts. He commenced the detachment at the edge of the cleft, and proceeded outwards, using rectangular knives. Langenbeck elaborated the method. He commenced the detachment from the side of the alveolus, insisted upon the importance of separating the periosteum with the mucous membrane, and used raspatories (*Weitere Erfahrungen im Gebiete der Uranoplastik mittelst Ablösung des mucusperiostalen Gaumenüberzuges*, Berlin, 1863).

Mr. Avery, of Charing Cross Hospital, is said to have been the first surgeon in England to close a cleft in the hard palate by operation (Holmes's "System of Surgery," 3rd edition, vol. ii., page 508).

Sir Thomas Smith showed the possibility of operating upon children under chloroform. To this surgeon is due the credit of having brought this once complicated and unsatisfactory operation to its present position of perfection and comparative simplicity.

Extent of the Cleft.—The extent of the defect may vary from a bifid uvula to a cleft involving the whole of the soft and the hard palate, and which, passing through the alveolus on one or either side of the os incisivum, ends in a hare-lip. The cleft may be limited to the soft palate, and if the velum be entirely divided there is usually some want of union at the same time between the palate bones. Clefts limited to the hard palate are almost unknown, and when existing are represented usually by certain congenital holes.

The defect in the hard palate may be limited to the palate bones, or may extend as far forwards as the apex of the intermaxillary bone, or may be completed by the division of the alveolus.

The defect is usually somewhat to the left of the median line, and the septum nasi—when the hard palate is involved—is commonly adherent to the margin of the palate process of the right maxilla. In severe cases the bony septum may

be quite free below from connection with any part of the palate.

Circumstances affecting the Operation.—The severity of any given case (from the point of view of operation), and the difficulty that may attend an attempt at closure, will depend, not so much upon the length of the cleft as upon its width in relation to the amount of tissue available for closing it. In the soft palate the velum on either side of the cleft may be, on the one hand, of considerable width and substance, or it may be, on the other, shrunken, small, and attenuated.

In the hard palate a great deal depends upon the height or pitch of the vault.

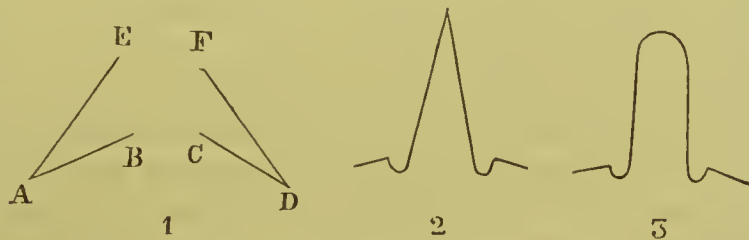


Fig. 294.—VARIETIES OF CLEFT PALATE.

In cases of highly arched palates which on transverse section would resemble a Gothic arch, the dissecting up of the flaps is comparatively easy, and their approximation a matter of little difficulty. If, on the other hand, the palate be but slightly arched, so that it would resemble on section a Norman arch, then there is difficulty in obtaining substantial flaps, and still more difficulty in bringing them together. Mr. Howard Marsh (*Lancet*, July 7th, 1888) well illustrates this by a simple figure. "Supposing that in each of two cases the cleft is half an inch wide, and that in one the arch takes the direction A B C D, and in the other the direction A E F D (Fig. 294, 1). When the soft parts are brought together the flaps A B and C D will be too short to bridge over the gap; but when the much longer flaps A E and F D are brought down, they will meet easily, and even overlap." The manner in which the cleft of the hard palate terminates anteriorly is a matter of great moment. If it ends in a point like a thin wedge (Fig. 294, 2), the shape is favourable. But if the anterior end is rounded "like the bow of a hair-pin"

(Fig. 294, 3), as Mr. Howard Marsh expresses it, a great difficulty is introduced in the operation. The union of the septum nasi with one maxilla is a favourable condition, since there will be furnished for one side of the cleft at least an abundant flap.

Not a little of the difficulty of the operation will depend upon the size of the mouth.

The factors which influence the operation are the health of the patient, his intelligence, his amenability to treatment, and his age.

On this last point the observations of Sir Thomas Smith, who must be regarded as the chief authority on palate operations, may be quoted.

Sir T. Smith condemns very early operations. "Doubtless," he writes, "the deformity can be cured in very early infancy, but, regard being had to the difficulty and even danger of the proceeding, and the many possible causes of failure at this period of life, it is prudent to postpone operative treatment. In the first three or four years of life clefts of the bony palate generally diminish greatly in width, especially at their anterior extremity, where in the process of growth fissures in the alveolar arch may be observed to close altogether by coalescence of their opposite edges. Thus with the lapse of time the operation becomes less difficult of performance, and no longer dangerous. . . . In deciding the question as to the best time for operating, the difficulty of the operation, and the constitutional condition of the patient, must be taken into consideration.

"In healthy children, clefts involving the velum only, without deficiency of the soft parts, may generally be cured in the third year of life. Fissures which affect the soft palate and more or less of the hard may, as a rule, be closed before the end of the sixth year if the cleft be not very wide, and there is a sufficiency of material for flaps.

"In cases of unusual local difficulty, or where the general health is feeble, or there is considerable infirmity of temper, the operation may need to be still longer postponed; but, if the case be curable at all, it is rare that this cannot be accomplished before the patient is twelve years of age.

"When, from one cause or another, the operation has been

long delayed, though a successful union may be more easily obtained, the results as regards articulation will be less satisfactory."

As another writer expresses it, the simpler the cleft, and the healthier the child, the earlier the operation.

Order of Operation.—In cases of complete cleft it was at one time advised that the defect in the velum should be first closed, and that the hard palate should be dealt with at a later period. Sir T. Smith, however, advocates that the union of both parts of the palate should be attempted at one operation.

This practice I have always followed, and the results have shown that the recommendation is sound.

Sir T. Smith makes one proviso. "When the bringing together of the whole cleft in one operation would necessitate so free a division of the soft parts as to endanger the vitality of the flaps, it is advisable to close first that part of the cleft that can be most easily approximated, whether it be the hard or the soft palate. This, if successful, will secure for the remaining portion a large supply of blood in the subsequent operation."

Instruments and Suture Material.—Probably for no operation have more numerous, more elaborate, or more remarkable instruments been devised than for the treatment of cleft palate. A great variety and complexity of instruments means not only a difficult operation, but also that successive surgeons have made attempts to assist clumsy or unskilled fingers by mechanical means. The various plugs, gags, forceps, knives, and needles, invented by one man or another, are legion, and to them must be added a medley of lip-holders, palate-holders, suture-twisters, and the like. The majority of these instruments are now fortunately obsolete. The surgeon should be able to work with simple instruments, and if he be unable to suture a cleft palate without an armoury of complex tools, he had probably better leave the operation undone.

The following are the *instruments* required:—Two sharp-pointed tenotomy knives in long and slender handles, for paring the edges of the cleft. A blunt-pointed knife of the same kind, for making lateral incisions to relieve tension. Fergusson's

rectangular knife, for tracing flaps when one has to be brought down from the septum nasi (Fig. 295). Two pairs of long, slender-bladed forceps, one serrated and one with tenaculum



Fig. 295.—FERGUSSON'S CLEFT PALATE KNIFE.

points. A fine hook (Fig. 296). A pair of small, sharp-pointed scissors curved to a quarter circle, for dividing the connection of the soft palate with the nasal mucous membrane at the pos-



Fig. 296.—CLEFT PALATE HOOK.

terior margin of the hard palate. Small blunt-pointed scissors, curved on the flat, for the sutures, etc. Palate raspatories curved as an aneurysm needle, and another raspatory very



Fig. 297.—SMITH'S RASPATORY.

slightly curved. Smith's raspatories (Fig. 297), or Ollier's instrument (Fig. 298), are admirably suited for the purpose. Two needles on long handles, and with eyes at the point (Fig.

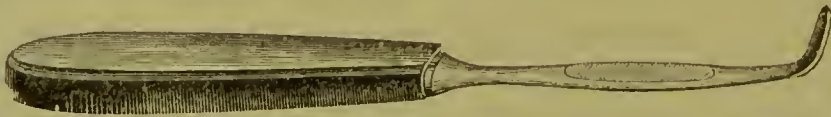


Fig. 298.—OLLIER'S CURVED RUGINE FOR THE PALATE.

299, Smith's pattern), for the fine sutures. Smith's instrument for catching the sutures at the eye of the needle (Fig. 300). A tubular needle, with a reel at the base for the wire sutures. A wire twister (Fig. 301). Ordinary torsion forceps make fair wire twisters. Many surgeons find needles twisted like a ram's horn, set in a handle, and with an eye near the point, most convenient. Some simple curved needles, and a plain needle-holder, may be useful.

For introducing silkworm-gut sutures rapidly Fitzgerald's needles (Fig. 302) will be found useful.

A loop of the gut is held in the needle, which has the slot



Fig. 299.—SMITH'S CLEFT PALATE NEEDLE.

directed towards its point. The needle is then thrust through one side of the palate, and the other needle passed unthreaded

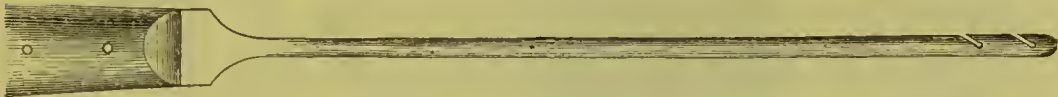


Fig. 300.—SMITH'S CLEFT PALATE SUTURE CATCHER.

through a corresponding point on the opposite side of the cleft. With this second needle the loop is caught in the slot, and both



Fig. 301.—WIRE TWISTER.

needles are then withdrawn. With slight practice the operator will find this method to be one of the most rapid.



Fig. 302.—FITZGERALD'S CURVED NEEDLES FOR STAPHYLOGRAPHY.

The ends of the needles are shown on an enlarged scale. The one with the slit pointed forwards is for introducing the loop of silkworm gut, the other for withdrawing it.

A gag is needed, and Smith's well-known instrument answers in most cases admirably. It is most important that it should fit the patient, and that it should be carefully adjusted. Sir T. Smith points out that cases are met with where the continued

depression of the tongue causes difficulty in breathing. In such instances Mason's gag may be used, and the tongue be held down by a rectangular spatula, or drawn downwards and forwards by a silk loop introduced through the tongue in the middle line by a mounted needle.

Whitehead's speculum is shown in Fig. 303. If it be necessary to hold aside the cheek, the square rectangular retractors used in nephrectomy answer admirably.

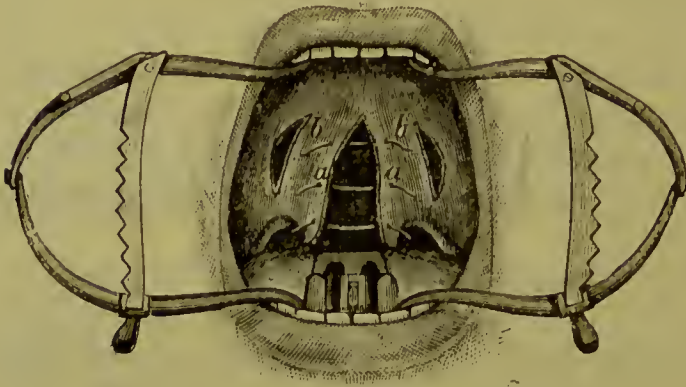


Fig. 303.—STAPHYLORAPHY. (Löbker.)

A number of small Turkey sponges in sponge-holders are required, and the necessary material for the various sutures.

With regard to the suture mate-

rial, much must depend upon the custom of the individual surgeon. Horsehair answers admirably for the uvula, and for the lower and flaccid part of the velum. It is distinctly not suited for any part where there is tension. The sutures should be of full length, should be carefully selected, and should be softened before the operation by immersion in warm sterilised water. Horsehair sutures should be tied in three knots.

For the principal sutures—for those that have to bear strain—silkworm-gut answers admirably. It causes, as a rule, no irritation. It should be prepared by immersion in hot water. The fine gut should be used, as it can be readily knotted, a single "surgeon's" knot being employed.

Position of the Patient.—The upper part of the body must be well raised, and the head be placed sufficiently high to prevent the surgeon from stooping. The head should rest upon a hard cushion, or be received in a depression in a sand-bag. It must be thrown well back. The table should be narrow. The surgeon stands on the right, facing the patient.

The anæsthetist takes his place on the left. One assistant, standing at the end of the table, fixes the patient's head and attends to the gag; a second assistant, at the surgeon's side, assists in the operation.

It has been advised that the head be thrown back so far that the vertex points towards the ground. By such means the palate is rendered horizontal and is under the surgeon's hands. Blood also cannot run down into the trachea. This posture is not so convenient as it may appear, is apt to cause great engorgement of the head, and will be found in practice to have little to recommend it.

The question of the anæsthetic is important, and a practised and skilful anæsthetist is essential for the successful work of the operator. During the actual operation, chloroform is generally given by a Junker's inhaler and nasal tube, or else on a flannel mask used intermittently. The danger of chloroform, however, makes it advisable that ether should be given until the patient is under, as thereby the risk of heart failure is decreased.

When the operator stops to allow the anæsthetist to work, pressure should be made on the bleeding edges of the palate by means of sponges on holders.

OPERATION ON THE SOFT PALATE.

The gag having been introduced, the first step is to pare the edges of the cleft. The tip of one half of the uvula is seized with the tenaculum forceps, and is drawn upon so as to make the palate tense. With a sharp-pointed knife the edge is now pared from below upwards, *i.e.* from the free margin of the velum towards the hard palate. The knife may follow the anterior angle of the cleft (assuming the hard palate to be sound), and may return in the opposite direction along the other margin of the cleft, that side of the velum being made tense in turn.

The whole of each side of the cleft must be well and liberally freshened. The anterior angle of the cleft and the tip of the uvula are especially apt to escape the knife. The raw surface should be wide, and of even width throughout.

Scissors should never be used to freshen the edges.

There will probably be no need for the flaps to be again touched with the forceps when this stage has been completed.

The next step is the passing of the sutures. They should be introduced from below upwards. The first suture is passed through the halves of the uvula, and the two ends are held in a pair of Wells's forceps, so that it may be used to make the edges tense, and thus avoid any handling of the palate with forceps. The same course is adopted with the ends of each suture, so that when the moment arrives for tying them all there can be no confusion between the various sutures. Each Wells's forceps grasps the corresponding ends of a single suture.

The sutures must be placed at a sufficient distance from the margin of the gap to secure a good hold, and their number and arrangement must depend upon the degree of tension at any particular point.

The sutures should, whenever possible, be passed through both sides of the palate at one transit of the needle. The finer sutures (those for the uvula, for example) are passed by means of the rectangular needle (Fig. 299), the others by one of the needles in handles used for carrying wire or silkworm gut. If the edges of the cleft will come together, the sutures should be fastened off at once by tying.

If the cleft be narrow, the sutures can be passed without difficulty. If it be wide, some special method may have to be adopted.

The following is the most convenient:—A very long suture has a needle threaded at either end of it. One needle is passed through the left flap of the palate from behind forwards, and the other through the right flap in the same direction. The first needle passed must be held by an assistant while the other is being introduced. This is practically the method often adopted in closing an abdominal incision. The needles employed should be small and curved, and must be passed by means of a simple needle-holder. Needles of various curves should be at hand. In no operation is a complex needle-holder more out of place than in this:

Avery's method for passing the sutures may be employed in these cases. It is executed as follows :—

A needle in a handle carrying a long suture is passed through one flap of the palate (say the left) from before backwards. The loop is caught when the point of the needle is in the cleft, and is drawn out of the mouth. The needle is then withdrawn, leaving the loop *in situ*. A long suture is in like manner passed through the other flap (the right) of the palate. It is in like manner drawn through the cleft and out of the mouth, not in the form of a loop but as a single thread. The needle is withdrawn. The left half of the velum will therefore be pierced from before backwards by a loop of suture, the right half by a single thread. The single suture is passed through the loop. The loop is withdrawn, dragging the single suture with it. This suture therefore will have passed through the right half of the palate from before backwards, and through the left half from behind forwards.

“When there is too much tension to admit of the sutures being tied at once, they should all be passed, and, being held as described above, longitudinal incisions may be made on either side parallel to the cleft and just internal to the hamular process (Fig. 303), avoiding the immediate neighbourhood of the posterior palatine foramen. It is well to make this incision with a blunt-ended knife, after puncturing the palate with a sharp-pointed knife. Sufficient relaxation being obtained, the remaining sutures are tightened up” (T. Smith).

If after the lateral incisions have been made the tension is not amply relieved, it is well to introduce a slender-pointed raspatory or vivisector's tool through the incision, and with it to detach the muscular and tendinous structures from the hamular process. I have found such a step always to answer its purpose completely.

Sir William Fergusson divided the levator palati muscle by means of a rectangular knife, which was passed through the cleft and was made to sever the muscle by a transverse incision on the posterior aspect of the palate. Mr. Pollock divided both the levator and tensor palati muscles by means of a fine tenotome passed from before backwards through the velum just in

front and to the inner side of the hamular process. Neither of these measures for the relief of tension has proved satisfactory in practice, and both have been for the most part abandoned.

Throughout the operation, bleeding must be checked by gentle pressure with a sponge in a holder. The sponge should, however, be used as little as possible. The indiscriminate and persistent dabbing of the palate with a sponge tends to excite movement of the palatal and pharyngeal muscles, to produce vomiting and coughing, and to greatly increase the flow of saliva.

In the adult the saliva from the parotid may sometimes be seen to squirt in a jet into the mouth, after a vigorous sponging.

The operation may have to be suspended from time to time to give opportunities to the anæsthetist.

OPERATION ON THE HARD PALATE.

Before describing this operation, it should be noted that partial or complete failure is not an infrequent result, and that the chief reasons for this are the following :—

1. Operating on subjects at too early an age, or those who are not in a satisfactory condition of health.
2. Damage to the blood supply of the flaps during the operation.
3. Secondary hæmorrhage.
4. Failure to unite owing to the tension on the sutures not being overcome.

In some cases the supervention of scarlet fever or other illness may have prevented healing.

The flaps consist of all the tissues down to the bone. Formerly the bone itself and mucous membrane lining the floor of the nose was sometimes cut through on either side (Dieffenbach-Fergusson method) and the sutures passed through the whole thickness. This left a gap on either side. It was a rough procedure, and liable to be attended with much bleeding, and its practice has been abandoned.

In order to avoid tension when the sutures are secured, it is necessary in all cases to lift up with a raspatory the flaps from

the cleft outwards for a considerable distance, in addition to making an incision just behind the hamular process to free the soft palate. Particular attention must be paid to the junction of the hard and soft palate where the tissues are most firmly attached to the bone along the posterior edge of the hard palate: At this spot partial failure to unite is often met with in otherwise successful cases.

The blood supply of the palate, both hard and soft, is almost entirely derived from the posterior palatine artery — a branch descending from the internal maxillary. The posterior palatine vessels emerge through the bone just internally to the socket for the last molar tooth, and the branch for the hard palate courses forwards parallel to the alveolar margin (*see* Fig. 304).

The dotted line in the above figure shows where the incision

should be placed—*i.e.* it must be just internal to the alveolar border and external to the groove for the artery already referred to. The incision goes right down to the bone, but should stop short in front of the last molar tooth, lest the artery should be wounded as it leaves the posterior palatine foramen.

The cases of serious and sometimes fatal hæmorrhage following the operation have been those in which the latter accident has occurred.

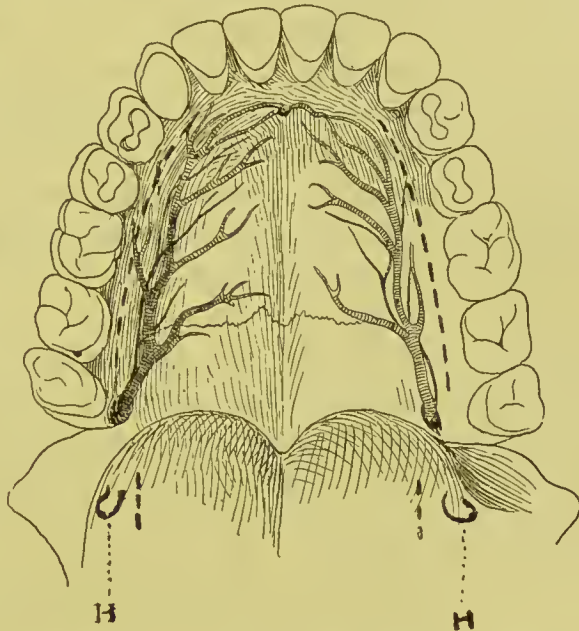


Fig. 304.—THE PALATINE ARTERIES IN RELATION TO THE OPERATION FOR CLEFT PALATE.

The dotted line on either side between the gum and the palatine artery and nerve shows where the incision should be made in order to displace these inwards uninjured in the flaps. H H, Hamular processes. A dotted line to the inner side of each hamular process indicates how the tensor palati may be divided so as to relieve tension.

An additional incision will be required through the soft palate internally to the hamular process.

The steps of the operation are as follows :—

1. The edges of the cleft are carefully pared along its whole length on either side, the soft tissues being raised from their attachment to the hard palate and nasal septum.
2. One lateral incision just within the alveolar margin (*see* Fig. 304) is now made, and with a curved raspatory the whole of the soft tissues are carefully detached as far inwards as the edge of the cleft. At the back the raspatory is made to lift off from the bone that part of the soft palate where it joins the hard. This is best done from the cleft. The bleeding in this stage may have been considerable ; it should be checked by pressure (made by the assistant with a sponge mounted on holder), whilst the operator proceeds to repeat the lateral incision on the opposite side. This incision is made in one case from before backwards, in the other from behind forwards. Sponge pressure will now be made on both sides, whilst the anæsthetic is resumed. The fauces need to be kept clear of blood by sponging, but this should be as sparing as possible, and done with the utmost gentleness.
3. The sutures are now introduced by one of the methods already described. The first will be passed through the soft palate at the base of the uvula. Traction made on this will steady the two halves, and ensure the others being placed at regular intervals. Fine silkworm gut is used, and the two ends of each suture are held outside the mouth in a Wells's forceps.

The sutures should be placed at fairly close intervals, about 8 to 10 mm. apart.

4. Each suture is tied in order, but before doing so the surgeon relieves tension as far as possible by the use of the raspatory, and by two short incisions through

the soft palate made just within the hamular process. Especial attention should be paid to the extreme anterior end of the cleft, and to the point opposite to the junction of hard and soft palate. The knots made are single surgeon's ones, so that the ends lie evenly against the palate and cannot irritate the tongue. The after-treatment of the case is described on page 78.

Note.—In the usual description of the operation the lateral incisions are placed more internally than above described—*e.g.* mid-way between the cleft and alveolus. As Tillaux pointed out, the branches of the palatine artery are then cut across. Placing the incisions close to the alveolus presents no special difficulties, and diminishes the risk both of hæmorrhage and of sloughing of the flaps.

In some cases of acquired aperture in the palate, or in those in which an operation has left a small cleft remaining, a different method will suffice. The edges being pared, a small flap from one or other side is shaped out and brought over to cover the cleft, or two reversed flaps may be used after Davies-Colley's method (*see* page 76). In either case the flaps should be somewhat larger than the cleft to be covered over.

Lannelongue's Operation by a Nasal Flap.—Lannelongue has in three cases closed a cleft limited to the hard palate by a rectangular flap obtained from the side of the nasal septum (*Bull. de la Soc. de Chir.*, 1877, page 472).

The size of the flap must depend upon the size of the gap to be closed. It is limited by three incisions: one superior and horizontal, and two lateral and vertical. The base or pedicle of the flap is therefore at the lower border of the nasal septum. The flap is detached by a suitable rugine from above downwards. The lateral border of the fissure is pared, and the flap is then drawn across the cleft and attached to the freshened margin by sutures.

This plan may be carried out when the septum is adherent to one margin of the cleft, and where the opening is—with reference to the nasal septum—unilateral.

The case must be exceptional in which this excellent pro-

cedure will alone suffice to effect a cure, but the operation may be of great value in supplementing the usual measure as described above.

Davies-Colley's Operation.—This operation is described in the *British Medical Journal* for Oct. 25, 1890 :—

First Stage.—A triangular flap (Fig. 305, *a b c*), consisting of the whole of the soft parts covering the bone, should be cut from that side of the hard palate which is the wider ; or if, as

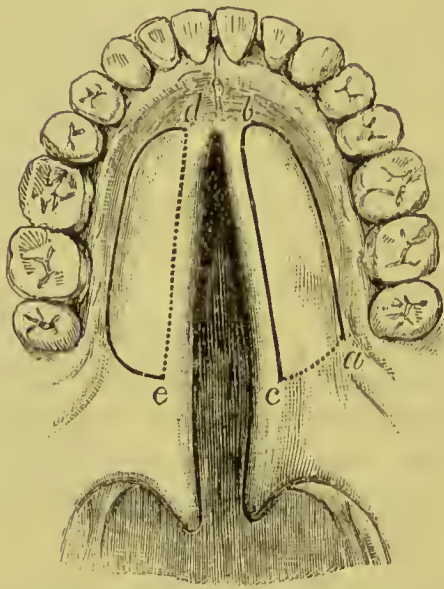


Fig. 305.—DAVIES-COLLEY'S OPERATION FOR CLEFT OF THE HARD PALATE.

The flaps (*a b c* and *d e*) marked out.

usually happens, the septum of the nose is attached to the palatal process of one of the superior maxillæ, the flap should be taken from this side. The apex of this flap should reach nearly as far forwards as the insertion of the incisor teeth (*b*, Fig. 305). The outer border of the flap should begin just internally to the back part of the alveolar process, and should run forwards parallel to the margin of that process. The inner side of the flap should run backwards one-eighth of an inch externally to the margin of the cleft, and should termin-

ate a short distance behind the posterior border of the hard palate. The base which is left attached will therefore extend from close to the inner border of the alveolus for the last molar teeth, inwards and slightly backwards to the edge of the cleft of the soft palate, near to its anterior attachment (*a c*, Fig. 305).

Second Stage.—An incision is made down to the bone upon the other side of the cleft, at least one-sixth of an inch externally to its margin. The greater part of the incision runs from before backwards parallel to the cleft. It should begin at the level of the anterior extremity of the cleft, and should end at the back of the hard palate (*d e*, Fig. 305). At its anterior and posterior

extremities this incision should be carried inwards to the margin of the cleft. A raspatory is now inserted, and by it the muco-periosteum internal to the incision is separated from the bone as far inwards as the margin of the cleft.

Third Stage.—The flap made in the second stage of the operation is now turned inwards upon the hinge, so to speak, formed by its attachment to the margin of the palatal processes of the superior maxilla and palate bone, and is fixed in this position (so as partly to bridge across the cleft) by two moderately fine catgut sutures passed through its edge, and the thin strip of mucous membrane which was left *in situ* on the opposite side of the cleft, internally to the triangular flap (Fig. 306).

Fourth Stage.—The apex of the triangular flap is now carried across the cleft, and the anterior part of its inner margin is attached by means of two or three silver sutures to the outer border of the incision upon the other side of the palate (Fig. 306). If there is any difficulty in carrying the triangular flap across the cleft,

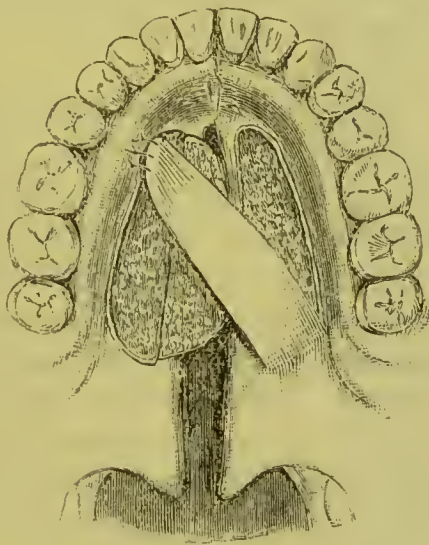


Fig. 306.—DAVIES-COLLEY'S OPERATION FOR CLEFT OF THE HARD PALATE.

The flaps in position.

it may be necessary to detach its base more freely from the soft parts which connect it with the back of the hard palate. It will usually be found that the triangular flap lies very loosely in its new position, but no fear need be entertained that on this account it will fail to unite. The upward pressure of the tongue will constantly maintain the raw surface, which forms the upper portion of the flap, in close contact with the raw surface which, if the third stage has been properly carried out, is directed downwards so as to form a bed for its reception.

The subsequent treatment of the case is in no wise different from that after the ordinary operation.

Comment.—The advantages claimed for this measure are these :—(1) There is less hæmorrhage ; (2) less bruising of the parts ; (3) less sacrifice of tissue ; (4) less tension upon the flaps ; and (5) the operation can be easily performed at an early age—*e.g.* between the ages of one and two years.

The disadvantages are :—(1) The hard palate alone is united ; (2) a foramen is apt to be left in the front part of the cleft. (This can be closed later.)

Mr. Davies-Colley recommends the operation in the cases of infants ; in cases where the usual operation has failed ; and where the gap is too wide to be bridged over by the usual operation.

After-treatment.—The patient should remain in bed for a week. No food of any kind should be administered until all vomiting has ceased. The diet should be simple, and may consist for the first day of milk or milk-and-water only, and after that of beef-tea, broth, eggs, arrowroot, custard and sago puddings, bread-and-milk, stewed fruit, and the like. Porridge, pounded meat, or fish may be given when a few days have elapsed. Two mistakes are frequently made in the after-treatment : one is to starve the patient, and the other is to feed him so frequently with small quantities of food that the pharyngeal muscles are never at rest. One author, indeed, says that food should be administered “unceasingly.”

The patient should be fed as an ordinary patient is fed, but the food must be fluid, or at least perfectly soft, and must be swallowed slowly and carefully. The pharyngeal muscles contract more completely around a small bolus than a large. This simple and almost fluid diet should be observed for two or three weeks, until, indeed, it is clear that the wound has healed, or has broken down hopelessly.

It is well to forbid much talking. For the first few days the less the patient speaks the better.

One important factor must not be overlooked—the mouth must be kept clean. It is often rendered foul by decomposing milk and beef-tea, which remain in the recesses of the mouth, owing to the patient's exaggerated belief in the evils which attend swallowing. The best wash is a warm solution of

carbolic acid (1 in 100 to 1 in 80). Boracic lotion also answers well.

The mouth should be rinsed out after every meal, and at other times as occasion suggests. I am in the habit of having the wound washed at least twice a day with a warm boracic solution, which is applied to the palate by means of a "scent spray." It is agreeable to the patient, and it keeps the part free from incrustation.

The advice that the palate in young children should not be inspected for one week after the operation is hardly consistent with the practice which obtains in the treatment of wounds elsewhere.

The sutures need not be removed until fourteen days or three weeks have elapsed. Sutures of silkworm gut and fine silver set up singularly little disturbance, and may be retained for weeks, but it is obvious that if firm union has not taken place in three weeks it will probably not take place in five.

Results.—The success of the operation may be compromised by severe vomiting, by the swallowing of solid food, by the development of whooping-cough or an eruptive fever, or by the feebleness of the patient's health.

It must be remembered that the closure of the cleft does not remedy the defective articulation. The soft palate in these cases of congenital deformity is not only deficient in the median line, but deficient as a rule throughout. It is unduly short, and after the most successful operation it is doubtful if the palate is ever so completely restored that it is capable of shutting off the mouth from the nasal passage.

The operation, however, places the patient in a position to attain a normal articulation. It enables him to be educated to speak naturally. This education is tedious, and involves a great expenditure of time and trouble, but it is remarkable what excellent results may follow, even in cases which cannot be considered from a surgical point of view to be eminently successful.

CHAPTER VI.

PLASTIC OPERATIONS UPON THE BLADDER AND URETHRA.

THESE operations will be considered in the following order:—

1. Operations for Epispadias.
2. Operations for Hypospadias.
3. Operations for Ectopia Vesicæ.
4. Operations for acquired Urethral Fistula.

OPERATIONS FOR EPISPADIAS.

This condition is less common than hypospadias, but at the same time causes much more disturbance and greater inconvenience.

It often exists as an isolated deformity, and quite independently of extroversion of the bladder, but all examples of the latter malformation are associated with epispadias.

There are various grades of the deformity, but the commonest condition is that known as the "complete form." In this the penis is much shortened and flattened, and is curved upwards towards the abdomen. It is compressed against the abdomen, and usually turns also to the left side. The funnel-shaped opening into the bladder may be of sufficient size to admit the finger.

The prepuce is usually large and depends like an apron. In the completer forms there is incontinence of urine, and great distress is occasioned by the continual escape of urine, and by the chafing and excoriation that follow.

It is noteworthy that after a successful operation, and often after one which is partly successful, some control is obtained over the bladder. The affection was at one time regarded as quite

incurable. Attempts to form a new roof to the urethra by means of flaps derived from the lateral parts of the penis failed. In 1852 Nélaton employed for the first time the method of reversed flaps, and since that date the treatment of this deformity has been placed upon a satisfactory basis:

A short account of the history of the operation will be found in Holmes's "System of Surgery," 3rd edition, vol. iii., page 686.

Preliminary Measures.—In the following chapter on the treatment of ectopia vesicæ an account is given of certain preliminary precautions which should be observed. To this account (page 97) the reader is referred.

In epispadias uncomplicated by ectopia it is usually necessary as a preliminary to *straighten the penis*.

This is imperative in those cases in which the penis is short and stunted, and is so turned upwards as to lie in close contact with the abdominal wall.

The position may be corrected by dividing the penis subcutaneously close to the os pubis, each corpus cavernosum being cut separately and completely by one or more incisions. The bleeding is easily controlled by light pressure. The penis must for some time be kept fastened down. The improvement in position takes place gradually, and there is at the same time an increase in length, which is the more marked the earlier the operation is performed.

It is well to allow some months to elapse after this measure has been carried out, before the plastic operation is undertaken, in order that the surgeon may be assured that the correction of the false position is permanent.

In Nélaton's operation for epispadias, one of the flaps is obtained from the median line of the anterior abdominal parietes. The skin of this flap forms the new roof to the urethra. If hair grow from it, therefore, it will grow into the urethral passage, and serious inconvenience may follow. If the patient have reached puberty the hair-bulbs should be destroyed by nitric acid after the manner described on page 98.

The general question of the after-growth of hair in these cases is there discussed.

Nélaton's Operation.—This procedure dates from 1852. The penis, if not in good position, may be fixed by a thread passed through the prepuce.

1. Two longitudinal incisions are made along the dorsum of the penis, one being placed on each side of the urethral groove. These incisions are parallel to one another and to the groove, and are placed a little externally to the outer margins of the

groove.

They terminate at the corona glandis by one extremity, and at the abdomen by the other. At each of these extremities of the two cuts two very short transverse incisions are made at right angles, and are directed outwards.

The minute and almost linear flaps thus marked out are dissected up as far as the lateral cuts will allow.

2. The proximal ends of the two longitudinal incisions are now carried vertically

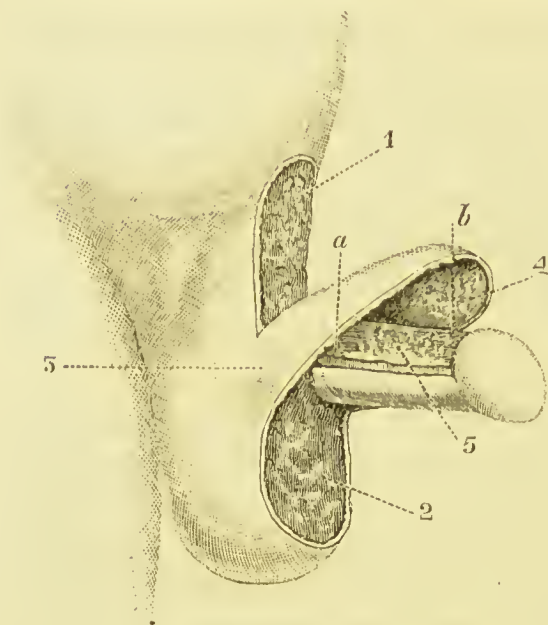


Fig. 307.—NÉLATON'S OPERATION FOR EPISPADIAS.

1, Raw surface left by abdominal flap; 2, Raw surface left by scrotal flap; 3, Pedicle of scrotal flap; 4, Scrotal flap; 5, Abdominal flap in position; *a b*, Free edge of penile flap, beneath which the margin of the abdominal flap has been introduced.

upwards on to the abdomen, and are united superiorly by a transverse wound. The abdominal flap is thus marked out. Its breadth exceeds a little the width of the interval between the parallel penile incisions, and its length is a little in excess of the length of the urethral groove which is to be covered in (Fig. 307, 1).

This narrow flap, when separated from the parts beneath, is turned down for the purpose of forming a roof to the urethra. The skin surface lies towards the penis, while the raw surface is uppermost or external (Fig. 307, 5). The edges are united

by sutures to the raw edges left by the dissecting up of the minute penile flaps (*a, b*). The free, upper or transverse, border forms the upper margin of the new meatus. The union of this flap is so made that the edges which are brought together overlap a little, the minute penile flaps overlapping the margins of the abdominal flap. An extensive union is thus obtained.

It was found that if the operation were left at this stage the abdominal flap would by its contraction shorten the penis, curve it upwards, and gradually expose again more or less of the urethral groove.

To prevent this Nélaton made an additional flap from the scrotum as follows:—

3. This flap is obtained from the anterior surface of the scrotum, and is limited by two curved incisions; the upper one circumscribes the under half of the penis, and follows the groove between the penis and the scrotum; the lower one is parallel to it, and is so placed that the length of the scrotal flap shall a little exceed the length of the penis. Both incisions are concave upwards.

The flap is liberated, except at the sides, where is a wide pedicle (3, Fig. 307). The penis is then slipped under the flap, and its raw surface is attached by sutures to the raw surface of the abdominal flap which is already in position (5, Fig. 307).

The edges of the scrotal flap are united to the edges of the two penile flaps (*a b*, Fig. 307), and the operation is completed by closing in the raw surfaces (1 and 2, Fig. 307) left respectively upon the abdomen and scrotum.

After-Treatment.—An india-rubber tube well oiled is placed in the new urethra and passed well into the bladder. It must be held in place by a couple of sutures.

The wound surfaces should be well dusted with iodoform and covered with a light dry dressing.

Dry and infrequent dressings are best suited for this class of case.

It may be possible to attach a long india-rubber pipe to the tube already in the urethra, and to allow the urine to drain away into a vessel under the bed.

If this be attempted, a loop of the pipe must be attached to

the bed cradle, so that the urethral tube cannot be drawn upon should the patient move in his sleep or turn over. The loop should give it sufficient play.

If this cannot be arranged, the patient must sit as nearly upright as possible, and a macintosh should be so arranged beneath him that the urine can easily drain away.

Constant care must be devoted to keeping the patient dry.

The bowels may be kept at rest for a few days.

In the case of a young child chloral may be cautiously given after the operation to keep the patient quiet.

A simple nutritious diet should be advised, and plenty of

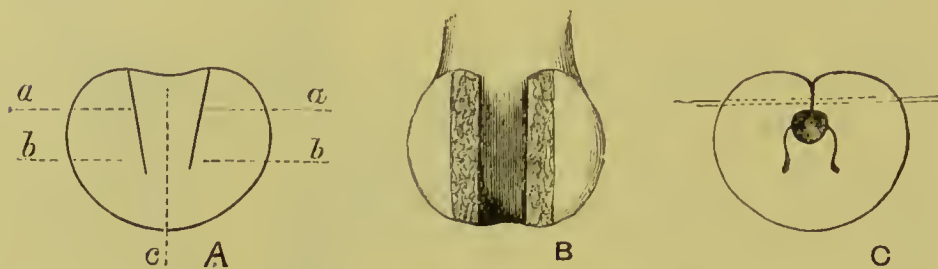


Fig. 308.—THIERSCH'S OPERATION FOR EPISPADIAS (FIRST STAGE).

fluid allowed, so that the urine may be as little irritating as possible.

The sutures will probably not be touched for eight or ten days. An anæsthetic may be necessary in order to carry out their removal safely.

The tube in the urethra may be removed in five or seven days, or less. If it excite undue irritation, or if urine escape by the side of it, it may be taken out earlier.

Result.—This operation has been fairly successful. The patient's condition is much improved, but two objections have to be noted. First, the glans remains uncovered, and, second, the new urethra is abnormally large. By means of Thiersch's operation an attempt is made to close the urethra without leaving these defects.

Thiersch's Operation.—This operation was described by Thiersch in 1869 (*Archiv f. Heilkunde*, 1869, Hft. I.). It has been adopted by many surgeons with excellent results. The procedure is divided into four stages.

First Stage.—Formation of a meatus and that part of the urethra which occupies the glans.

A deep incision (*a a*, Fig. 308, A) is made in the glans along each side of the urethral groove. These two incisions converge a little below and involve about three-fourths of the thickness of the glans.

They serve to separate the dorsal part of the glans into three parts—a median and two lateral (*c, b b*, Fig. 308, A).

The surface of the outer lip of each incision is pared for its entire length (Fig. 308, B), and while the median portion is depressed by means of a short length of catheter, which is introduced, the two lateral portions are brought together, and are united by means of fine needles and figure-of-eight sutures in the median line (Fig. 308, c).

The middle segment carries with it the whole of the mucous membrane, and its surface is, therefore, not disposed to unite with the raw surface, which at first forms the roof of the new urethra.

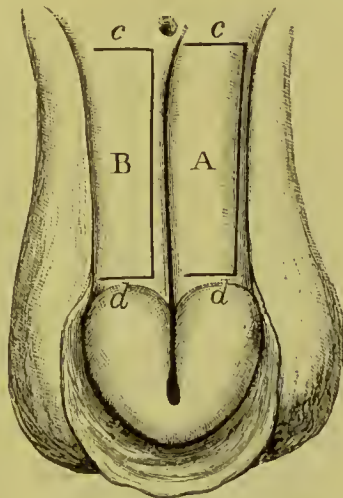


Fig. 309.—THIERSCH'S OPERATION FOR EPISPADIAS (SECOND STAGE).

Second Stage.—The formation of the penile urethra. When the wound in the glans has healed, and the pins have been removed, and when the urethral canal in the glans has been well established, the second step in the operation is undertaken.

An incision is made through the skin and subcutaneous tissues on the dorsum of the penis, on both sides of the urethral groove. The incision on the right side (Fig. 309, B) is made close to the urethral groove. The incision on the left is placed about half an inch from the left margin of the groove (Fig. 309, A). The two cuts are parallel to one another. By means of the transverse incisions (*c c, d d*) two long narrow flaps are marked out. The right flap (B) has its free edge abutting on the urethral groove, while the left flap (A) has its base in that position. (See also Fig. 310, 1.)

The two flaps are then dissected up, and are made as thick as possible.

The left flap (Fig. 310, A) is now turned over to form the roof of the new channel, its raw surface being uppermost. A

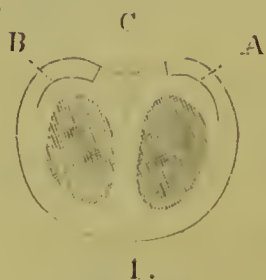


Fig. 310.—THIERSCH'S OPERATION FOR EPISPADIAS (SECOND STAGE).

row of sutures is passed through it, near to its free margin, in the manner shown in Fig. 310, 2, and Fig. 311, and the sutures are then made to pass

through the base of the right flap (B). They are finally secured by shot or quill attachment (Fig. 310, 2, and Fig. 311). The left flap (Fig. 310, A) thus forms the roof of the new urethra, while the right flap (B) covers over the raw surface of the left flap. The free edge of the right or surface flap is secured to the left side by a series of simple sutures, as shown in Fig. 310, 2, and Fig. 311.

A tube, which has been already introduced along the whole length of the urethra, from the meatus to the bladder, is retained, if necessary, until the wounds have closed.

When this stage is completed, and the incisions have entirely healed, the third step is undertaken.

Third Stage.—The covering-in of the small gap (Fig. 311, c) left in the roof of the urethra between the glans and the body of the penis.

To effect this the apron-like fold of the imperfect prepuce is made use of. This piece of skin is stretched, and a transverse button-hole incision is made in it. Through this slit the glans is slipped:

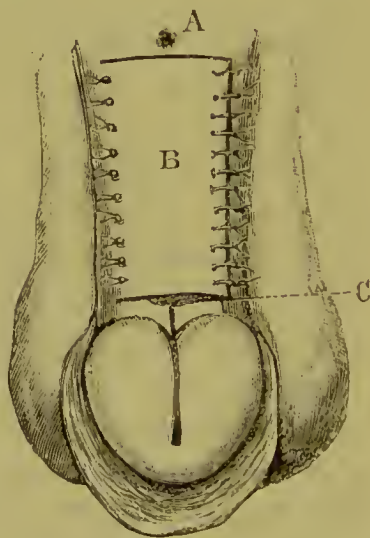


Fig. 311.—THIERSCH'S OPERATION FOR EPISPADIAS (SECOND STAGE COMPLETED).

That part of the pendulous prepuce which was lowest now becomes uppermost.

The margins of the glans and of the skin on the dorsum of the penis which bound the little gap are freshened, the ring of the displaced prepuce is interposed between them, and the raw edges, or surfaces, thus brought together, are united by sutures (Fig. 312). Another long interval is allowed for recovery.

Fourth Stage.—The closure of the funnel-shaped opening which leads into the bladder.

Two flaps are employed for this purpose, and one is taken from each inguinal region.

The flap taken from the left side is of triangular shape (Fig. 313, A), its base corresponding to the left half of the upper circumference of the bladder orifice. It is turned downwards, with the raw surface outermost, and is secured to the freshened margin of the skin forming the roof of the new penile urethra (Fig. 313). The right flap is long and quadrilateral, and has its base in the inguinal region, parallel to Poupart's ligament (Fig. 314, B).

It is placed over the raw surface of the left flap, and is fixed by sutures to

this flap, to the skin to the left of the base of the same flap, and to the freshened area which surrounds the upper border of the bladder orifice (Fig. 314).

Comment.—If a proper interval be allowed between each stage of the operation, some months will elapse before the treatment has been completed.

The operation may fail at one stage, and may need to be repeated.

Thiersch at first established a perineal fistula as a preliminary measure, in order that the course of the urine might be diverted during the period covered by the operations, but subsequent experience has shown that such a step is not necessary.

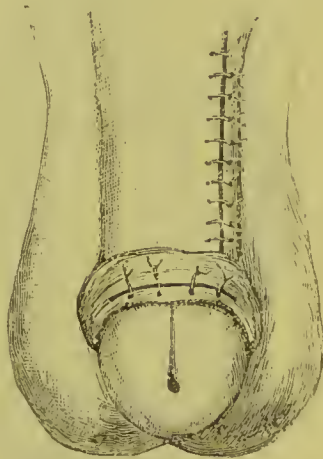


Fig. 312.—THIERSCH'S OPERATION FOR EPISPADIAS (THIRD STAGE).

Duplay's Operation.—*First Stage.*—The penis is straightened (page 81).

Second Stage.—The urethra is formed. No flaps are used, but the new canal is formed almost exclusively at the expense of the corpus spongiosum and corpora cavernosa.

If the groove be shallow, a median incision is made along its whole length to render the adjustment easier.

The tissues on each side of the groove are now freshened, the raw surfaces taking the form of strip-like quadrilateral areas,

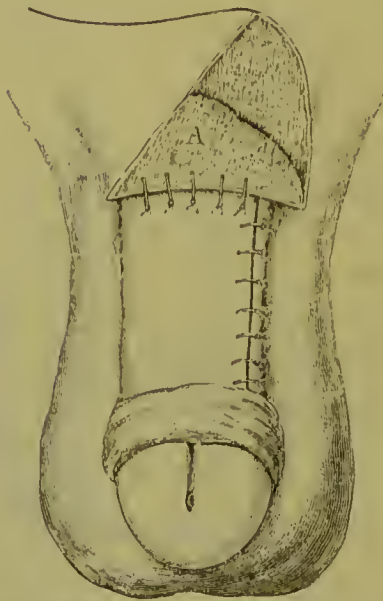


Fig. 313.—THIERSCH'S OPERATION FOR EPISPADIAS (FOURTH STAGE).

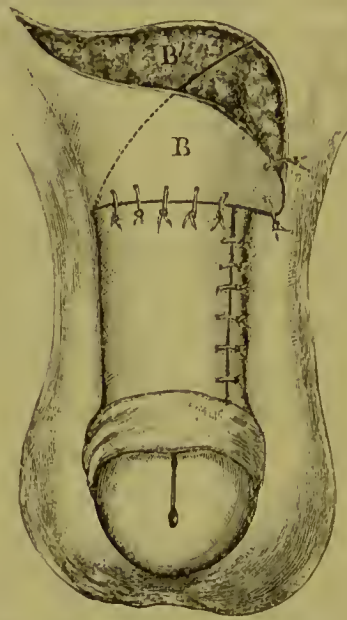


Fig. 314.—THIERSCH'S OPERATION FOR EPISPADIAS (FOURTH STAGE).

about half a centimetre wide, which traverse the whole length of the penis, and follow the margins of the median groove (*a b*, *a' b'*, Fig. 315). The freshened surfaces are now brought together in the median line by means of the quilled suture, which is introduced in the manner described in Duplay's operation for hypospadias (page 92).

Before the sutures are secured, a catheter is introduced into the groove, and is allowed to remain in the new canal. Its extremity enters the bladder, and it is employed until the wound has healed (Fig. 316).

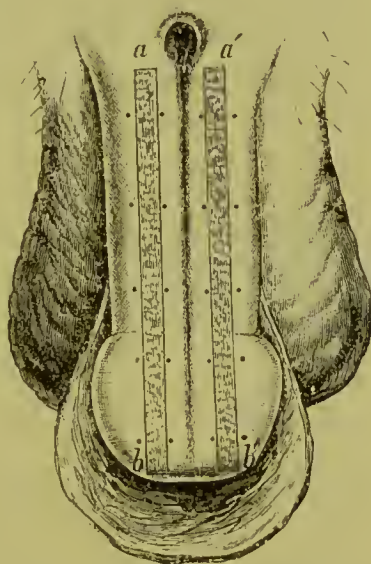
Third Stage.—The treatment of the prepuce. The prepuce

is treated as in Thiersch's operation, is pierced, and is brought on to the dorsum of the penis, where it is made—when sutured to a properly freshened surface—to provide a sounder covering of integument for the distal part of the dorsum of the penis.

By means of this flap of prepuce any little orifice which may remain open after the second stage of the operation is closed.

Fourth Stage.—The closure of the funnel-shaped opening which leads into the bladder. This Duplay effects by freely freshening the opposed surfaces, and then approximating them and uniting them by shotted sutures.

In the *slightest forms of epispadias* there is no incontinence, and the deformity causes no trouble, but the appearance of the penis may be considerably improved by transplanting the redundant prepuce in the manner described in the third stage of Thiersch's operation.



OPERATIONS FOR HYPOSPADIAS.

This, the commonest of all the malformations of the urethra, has been the subject of a very large number of more or less complicated operations.

The varieties of the deformity are classified according to the position of the opening of the urethra. In front of the opening the urinary passage is either entirely absent or is represented by a groove, or by a partly pervious canal.

1. *Balanitic.*—The opening is here at the site of the corona, the frænum is absent, and a hood-like prepuce exists.

2. *Penile.*—The urethra may open at any part of the under-surface of the penis, and if the opening be far back nearly the whole of the penile urethra will be wanting, so far as its floor is concerned.

Fig. 315.—DUPLAY'S OPERATION FOR EPISPADIAS. (Ashhurst.)

3. *Scrotal*.—Here the opening is either at the junction of the penis and scrotum (peno-scrotal), or is on the perineal side of the scrotum (perinco-scrotal).

In all but the slighter cases the penis is small and deformed. It may be attached to the scrotum by a cutaneous web, or be held in a eurved position by a fibrous band upon its under-surface, which represents the undeveloped urethra and the capsule of the corpora cavernosa. In extreme cases of curving of the penis the glans is forced against the scrotum, and only the dorsum of the shortened penis is visible.

Purpose of Operative Treatment.—There is very rarely any ineontinenee with hypospadias, and in common cases of



Fig. 316.—DUPLAY'S
OPERATION FOR EPI-
SPADIAS.

slight degree no serious ineonvenience is complained of. The main difficulties depend upon the arching of the penis, and the existence of an opening far back. The curving of the penis renders mieturition difficult and coitus impossible. Every time the patient makes water the serotum and perineum are wetted with urine; and if care be not constantly taken, these parts may

become eczematous. The urethral opening may also be so narrowed by the curving of the penis that mieturition is impeded.

If any operation be carried out, it should be made without delay. If the deformity can be corrected early, the penis may, as growth proceeds, assume a very fair degree of development.

If the condition has been left untreated until the patient has reached adult life, it had better be left altogether. In such a case the man will have learnt how to overcome the difficulties of mieturition. The penis, if it could be straightened (and it is not always possible at a late period) would be found to be short, wasted, and stunted. In these cases the testes are not uncommonly found to be small and atrophied, and the patient's sexual instincts are only slightly developed.

In the balanitic form of hypospadias an operation can seldom be called for, and the deviation from the normal condition may be so slight as not to cause any appreciable ineonvenience.

Attempts to make a new urethra through the glans by perforating that structure by a trocar (Dupuytren) are quite unjustifiable.

The accepted operations for hypospadias have in view two objects: (1) the correction of the malposition of the penis, and (2) the restoration of the canal of the deficient urethra.

1. The malposition of the penis may be corrected by means of one or more transverse incisions which divide the band of contracted tissue passing between the glans and the hypospadiac opening. To overcome the curving of the penis completely it may be necessary to carry the incision deeply into the substance of the corpora cavernosa. It is usually better to effect this division through an open wound, the integumentary edges of which are united subsequently by sutures.

In the slighter cases a subcutaneous division may be possible.

Before proceeding further with the treatment of the case, some six or eight months should be allowed to elapse, in order that it may be made evident that the correction of the false position has been permanent.

2. The restoration of the canal may be effected by one or other of the following operations.

Duplay's Operation.—*First Stage.*—The penis is straightened.

Second Stage.—A new meatus is formed. This is effected by freshening at their lower parts the two lips ($b b'$, Fig. 317) of the depression

which represents the meatus, and by placing between these two lips a small ca-

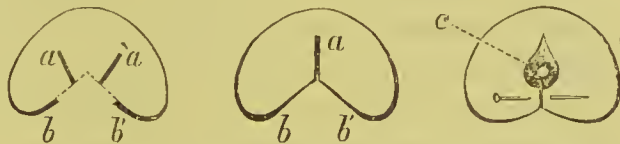


Fig. 317.—DUPLAY'S OPERATION FOR HYPOSPADIAS.

theter tip (c , Fig. 317), over which the freshened surfaces are united by several points of suture. If the depression be too shallow to permit the formation of a large enough meatus, two small lateral incisions ($a a'$, Fig. 317), or a median incision, a , made in the substance of the glans, will make it possible to introduce the tip of a catheter of proper size.

This part of the operation may be carried out at the same

time that the penis is straightened, and the duration of the treatment be thus shortened.

Third Stage.—The new canal is formed.

On the lower surface of the penis, on each side of the median line, and some millimetres outside of this line, a longitudinal incision, $a b, a' b'$, is made, extending from the base of the glans to within 1 cm. or even $\frac{1}{2}$ cm. of the hypospadiac opening (c , Fig. 318).

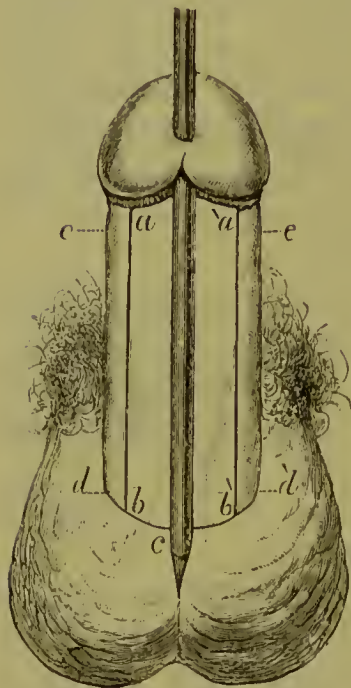


Fig. 318.—DUPLAY'S OPERATION FOR HYPOSPADIAS.

The internal lip of the incision is now slightly dissected up, so that the narrow strip of skin between the wound and the median groove may be inclined inwards as a species of flap (the so-called inner flap) over the catheter, but without attempting to cover it entirely. On the other hand, the outer lip of each incision is to be dissected up freely, so as to draw towards the median line the skin of the lateral parts of the penis, $e d, e d'$. This skin is brought forward in the form of a loose flap (the so-called external flap). The cutaneous surface of the inner flaps is thus turned towards the cavity of the canal, whilst their raw surface is

turned towards the outside, and is covered by the raw surface of the two external flaps. Although the catheter is thus not wholly covered by a cutaneous surface, Duplay has found no inconvenience to result from that circumstance.

The displaced flaps are now united in the median line by means of a quilled suture. Very fine silver wire is used; each suture is made of a single wire, and is separated from its fellows by a distance of $\frac{1}{2}$ cm. The ends of each wire are passed through holes made in small leaden tubes, and are fastened by perforated shot (Fig. 319).

If the surfaces approximated by this suture leave a little

separation externally, union is completed by a few superficial points of interrupted suture (Fig. 319).

Fourth Stage.—The two parts of the canal are united.

The margins of the openings to be approximated are freshened, and the raw edges are then drawn together and united—over a catheter—by means of a deep quilled suture and some interrupted superficial sutures.

The catheter is retained during all stages of the operation until healing is assured.

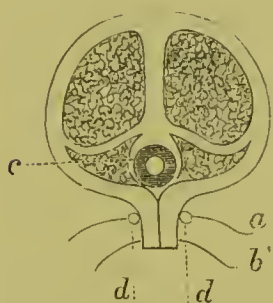


Fig. 319.—DUPLAY'S OPERATION FOR HYPOSPADIAS.

a, Deep sutures; *b*, Surface sutures; *c*, Catheter; *d*, Leadentubes or quills.

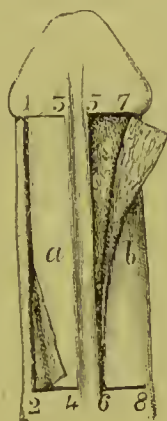


Fig. 320. — ANGER'S OPERATION FOR HYPOSPADIAS.

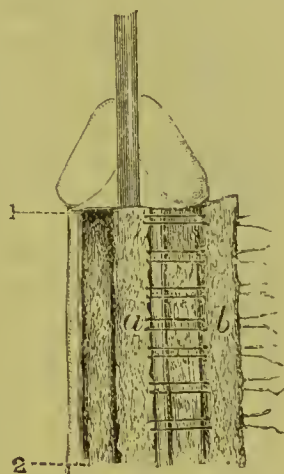


Fig. 321.—ANGER'S OPERATION FOR HYPOSPADIAS.

An interval of some months should be allowed to elapse between the third stage of the operation and the fourth.

Anger's Operation.—The operation, as here described, does not include the formation of a meatus. It is assumed that the penis has been straightened.

An incision (1 2, Fig. 320) is made on the right side of the penis from the glans to the scrotum, and half an inch from the median line. The transverse cuts, 1 3, 2 4, serve to mark out a flap (*a*, Fig. 320). This flap is dissected up and has its base along the median line. A second longitudinal incision, 5 6, is made to follow the left margin of the urethral groove. Two transverse cuts, 5 7, 6 8, about an inch in length, are made at each extremity of it. A flap (*b*, Fig. 320), with its free margin bounding the urethral groove, is thus marked out.

It is dissected up, and will possess at least double the width of the right flap (*a*).

A catheter having been introduced into the bladder, the first flap *a* is turned over so that its cutaneous surface covers the catheter (Fig. 321). Sutures are then passed as follows. Very fine silver or silkworm gut is used. To each end of the suture a slender needle is threaded. Each needle is made to transfix the free margin of the first flap *a* from the skin surface to the raw surface. The loop will be on the cutaneous surface.

Both ends of each suture (*i.e.* both needles) are then made to transfix the base or outer part of the left flap (*b*, Fig. 321), and in the cutaneous surface of that flap they are secured by shot (Fig. 322, *s*).

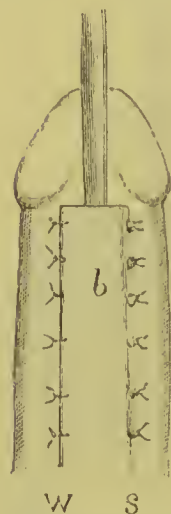


Fig. 322. — AN-
GER'S OPERA-
TION FOR HY-
POSPADIAS.

The left flap (Fig. 321, *b*) is drawn to the right so as to cover the raw surface of the first flap (*a*), and the free edge of this more superficial flap is then united by interrupted sutures (Fig. 322, *w*) to the raw border left by the incision 1 2, Figs. 320 and 321.

Other Operations have been devised, but they call for no very full description. An account of *Szymanowski's* most ingenious, but not very practical, operation will be found conveniently summarised in Stephen Smith's "Operative Surgery." Professor Wood and others have made use of the redundant prepuce (which is usually present in hypospadias) to close in the canal in whole or in part. This can be most conveniently carried out when the urethra is wanting to the extent of its anterior half only. When the deformity extends as far back as the serotum, the late Professor Wood supplemented the flap taken from the prepuce by a flap cut from the front of the scrotum.

Wood's method of arranging the preputial flap is as follows :— A transverse buttonhole incision is made in the prepuce close to the coronal groove on the dorsum. The glans is slipped through the aperture made. Two lateral flaps are dissected up from the penis upon either side of the urethral groove, and,

being reversed, are turned over, so that the skin surface is towards the new canal. These flaps are united by a continuous suture of fine catgut. The transposed dorsal prepuce is then "split up into two layers at the cut edge, which is opened and spread out over the raw surface of the reversed urethral flaps, and stitched to the edges by closely applied sutures of fine silver wire" (Heath's "Dictionary of Surgery," vol. i., "Hypospadias").

Comment.—In criticising this operation, it may be pointed out that the integument of the prepuce and scrotum is not well adapted to form the tissue of a primary flap. It is not readily handled, and the lax subcutaneous layer renders œdema a troublesome complication. The prepuce may serve a useful purpose in assisting to close a small defect and in supplementing a more extensive operation, but it has not yielded satisfactory results when used to form the principal flap.

From Mr. Wood's account it is to be inferred that the lateral, or urethral, flaps are united in the median line, and to this practice also some exception may be taken.

CHAPTER VII.

OPERATIONS FOR ECTOPIA VESICÆ.

Condition of the Patient.—Ectopia is more frequently met with in males than in females, in the proportion of ten to one. It is invariably associated with epispadias. When the urine is ejected in a decided jet on coughing or crying, some dilatation of the ureters is indicated. “Just on the upper margin of the red protruding mass (formed by the bare wall of the bladder) is a creseentic border of cicatricial tissue, which really represents the upper or omphalo-mesenteric part of the umbilicus. Above this will be seen and felt, in the median line—especially when the recti abdominis are put into action—a flat surface, hard and resisting, of from an inch to two or even three inches wide, bounded on each side by the recti muscles, and tapering upwards to the ensiform cartilage. This is the widened and expanded linea alba, and the structures covering the peritoneum here are sometimes very thin, although tough and resisting. The skin over this inter-rectal interval is smooth, and usually free from hairy growth. The recti are separated by the whole extent of the wide divergence of the superior rami of the pubes from the middle line” (Wood).

The scrotum is wide and shallow as a rule, and the testes are often in the groin. An oblique inguinal hernia often exists on one side or on both sides. The perineum is shorter and wider than normal, and the pubes are separated to the extent of from two to four inches.

The patients are often feeble and sickly. Renal disease, in the form of surgical kidney, is not uncommonly present, especially in the older patients. It is a frequent cause of failure and of death after operation.

The ureters may be greatly dilated, and the kidneys cystic.

Patients, however, with ectopia have lived to reach old age without having undergone treatment of any kind.

The distress caused by this deformity is terrible. The urine is constantly dribbling away. The thighs, scrotum, perineum, and abdomen are wet with urine and excoriated. The patient's clothes are soaked with urine, and the exposed portion of the bladder is commonly in a condition of cystitis.

Up to the present time no entirely satisfactory results have attended the use of the many forms of apparatus designed for ectopia. There is the difficulty of collecting the urine in all positions of the body without so pressing upon the integument as to produce excoriations or ulcers. The best apparatus is that by Wolfermann (Demme's model). A description of this appliance, with an illustration, will be found in Ultzmann's monograph on the bladder in the *Deutsche Chirurgie*, Lief. 52, 1890.

For a consideration of the value of operative treatment in these cases, see the section which follows on the Results of Operation, page 111.

Age for Operation and Preparatory Treatment.—Operative treatment may be commenced when the patient is four or five years of age. It should in any case be undertaken and completed before puberty.

The treatment will extend over many months, and will usually occupy more than a year.

During this period the patient will be subjected to many operations. In a case quoted by Billroth the treatment occupied twenty-two months, during which time nineteen operations were performed. This experience is not exceptional.

Before the operation is commenced it is most important that the patient be in good health. There should be no cough, the bowels should be acting normally, the urine should be healthy and not irritating, and the skin as free from inflammation and eczema as is possible. The cystitis also must be dealt with. Much can be done by frequent bathing, and by soaking up the urine by pads of compressed cotton-wool which have been impregnated with corrosive sublimate. To keep a patient dry

by these means will require the unremitting attention of a nurse night and day.

In order that the patient may be in the best condition, a long rest in the recumbent position is desirable, during which time much may be done by constant irrigation and unremitting attention to get both skin and mucous membrane into a healthy condition.

When a reversed flap is employed, and the integumentary surface is turned in towards the bladder, some trouble may result from the *growth of hair* from the displaced skin. The hair, if it attain any length, may block up the new urethra, and may lead to an accumulation of phosphatic concretions and other complications. Its growth is most likely to give trouble when well-developed hair is already growing upon the flap, as may be the case in an adult. When, however, the operation is carried out in very young subjects, the growth of hair seems to be subdued altogether. In other instances in which the hair has continued to grow it has been observed that the growth has declined in vigour as time went on, and that it has ultimately ceased entirely.

In cases where the hair at the time of the operation is unduly abundant, it is best to remove it by some depilatory. Mr. Wood recommends a drop of strong nitric acid applied at intervals, until all the hair is destroyed. When the acid is being applied, the skin and exposed mucous membrane must be carefully protected by a mixture of olive oil and chalk applied in a thick layer. No operation would be attempted until the skin thus treated has soundly healed.

Methods of Operating.—The very numerous operations advised or adopted in cases of ectopia vesicæ may be divided into three classes:—

1. Operations designed to divert the urinary passages.
2. Operations for closing in the defect by means of flaps.
3. Operations for narrowing the defective area by approximating the two innominate bones.

1. OPERATIONS DESIGNED TO DIVERT THE URINARY PASSAGES.

The procedures merely require to be enumerated. They have been up to the present time attended by great ill-success.

John Simon (*Lancet*, 1852, vol. ii., page 570) succeeded, by means of threads passed from the ureters into the rectum, in effecting a communication between the bladder and the bowel. Some urine passed *per rectum*, but much still escaped over the pubes, and the raw surface of the bladder was left uncovered.

Several operations, with the same object of diverting the urine into the rectum, have been carried out, but with doubtful success, and with many deaths.

Sir T. Smith's attempt to secure the ureters to the ascending and descending colon ended in failure (*St. Bartholomew's Hospital Reports*, vol. xv., page 9).

Sonnenburg (*Deutsche Chirurgie*, Lief. 52, 1890) succeeded in extirpating the bladder in a case of ectopia vesicæ in a boy aged nine, and in uniting the ureters to the dorsal groove of the penis. The bladder was separated without injuring the peritoneum. Catheters were introduced into the ureters, and tied there. The whole of the bladder was removed, and the ureters were cut free. The ureters were sutured to freshened surfaces on the dorsum of the penis. The gap in the abdominal wall was closed by flaps without difficulty. The ureters became fixed in their new situation, and healing is said to have been perfect.

2. OPERATIONS FOR CLOSING IN THE DEFECTS BY MEANS OF FLAPS.

The early flap operations were more or less uniformly unsuccessful. Attempts to close in the opening by definite flaps were made as far back as 1844. The flaps were not reversed, and failure followed.

Reversed flaps were first employed by Roux, Richard, and Paneoast.

Roux (*L'Union Méd.*, 1853) dissected one flap from the abdomen above, and another from the scrotum below, and united them in a reversed manner over the exposed bladder, so that the raw surfaces were turned outwards. Both flaps sloughed.

Richard (*Gaz. Hebdom.*, vol. i., 1854), following the lines of Nélaton's operation for epispadias, attempted a like operation a little later, but with a fatal result.

Dr. Ayres, of New York, operated upon an adult female in 1858 ("Congenital Exstrophy of the Urinary Bladder," New York, 1859) by turning down a flap of skin from the abdomen over the bladder. The cutaneous surface of this flap was turned towards the bladder. Its raw surface was covered by a process of gliding. The result was not very encouraging.

Dr. Paneoast, of Philadelphia (*North American Medical and Chirurgical Review*, July, 1859), carried out an operation in the same year (1858) which proved to be more successful.

Two lateral flaps were dissected up on either side of the defect, and were turned over so as to cover the bladder (their cutaneous surfaces being innermost). The flaps were reversed, but not superimposed. Union took place between the edges of the flaps.

Mr. Holmes first employed reversed and superimposed flaps with success in England, in 1863 ("Surgical Treatment of Children's Diseases," 2nd edition, page 149).

From these early operations the present more successful procedures have been derived.

The two principal methods now in use are known as—

A. Wood's operation.

B. Thiersch's operation.

These may be regarded as two standard procedures, founded upon different principles, and forming the bases for many modifications.

An account of Maury's operation will be added.

A. **Wood's Operation.**—Here three flaps are formed—a reversed upper or umbilical flap, and two lateral transplanted flaps, which are made to cover the upper flap. The following description is derived from Prof. Wood's account in Heath's "Dictionary of Surgery," 1887.

1. *The Cutting of the Flaps.*—The upper flap (Fig. 323, c) should be figured by a line extending along the side of the bladder surface vertically upwards as far as the measured distance from the root of the penis to the upper margin of the bladder, and then carried in a rounded curve across the "linea alba" at this point to join another vertical line of equal length on the opposite side of the bladder.

The two groin flaps (Fig. 323, A, B) for superposition are to be made of a rounded lancet shape, with the roots downwards and inwards at the base of the scrotum, and continued along

the side of the urethral groove for about half its length. These flaps should be long enough and detached enough to meet in the median line for their whole length, and no sharp angles should be left in their outline. The incision for making them should join that of the lateral border of the first or umbilical flap at about its centre.

In raising the umbilical flap care must be taken not to make the skin too thin, which is apt to be done in the centre of its base near the upper margin of the bladder. The tissues are here so thin that there is danger of wounding the peritoneum.

The flaps should be handled with the fingers rather than with forceps. In raising the lateral flaps the superficial external pudic arteries are cut and may need to be ligatured. All bleeding must have been

checked, and all clots removed, before the flaps are placed in position.

2. *The Adjusting of the Flaps.*—The upper flap is folded evenly down with its skin surface to the bladder, and is attached by sutures (Professor Wood uses silver wire) to the cut edge at the root of the penis on each side.

The groin flaps are then placed upon the raw surface of the umbilical flap. Their inner edges are united by sutures in the median line, and their bases should closely embrace the root of the penis. The raw surface left by the removal of the umbilical flap is closed by drawing the edges together with hare-lip pins. The surfaces left in the groin were in Professor Wood's first operation treated in the same way, but he now

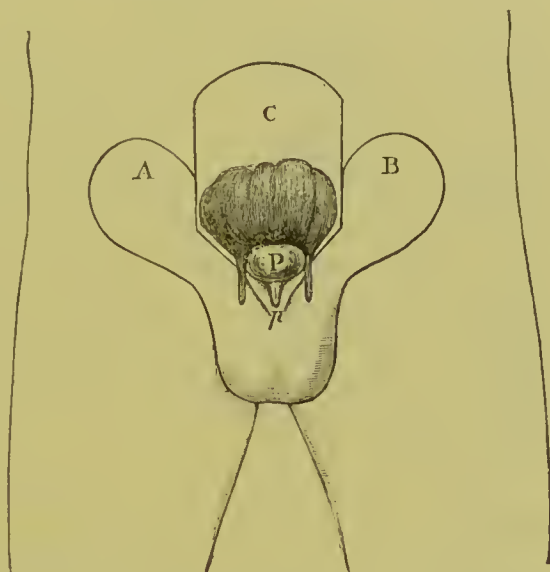


Fig. 323.—WOOD'S OPERATION FOR ECTOPIA VESICÆ.

A B, Lateral flaps; C, Upper flap; P, Prostate; p, Penis.

advises that the upper borders of the groin flaps be held upwards by one or two wire sutures, and that the raw surfaces which remain should be left to heal by granulation (Fig. 324).

In the Female the umbilical flap should be large, and the incision for the groin flaps on each side should be carried well down, so as to have their roots in great measure connected with the labia. When the flaps are finally sutured together, the vagina should be almost closed up by them, with but a small opening to allow the passage of the urine. (See Mr. Mayo Robson's modification of the operation, page 103.)

3. *Treatment of the Epispadias.*—This is effected by Nélaton's operation modified to meet the altered condition of the parts above the opening into the bladder. (See page 82.) In the place of the abdominal flap there described an incision is made parallel to and half an inch above the arched cicatrised urethral border of the covering of the bladder, and the integument thus marked out is then turned down in the form of a fold, with the skin surface directed towards the upper surface of the penis.

With this exception the operation follows the lines already indicated.

Comment.—This operation meets successfully the two great difficulties which attended early procedures.

1. In these cases a sinus was left at the site of the umbilicus which it was found almost impossible to close.

Such a result may be certainly expected if lateral flaps are employed in the fresh state without reversion or without the addition of the umbilical flap.

2. The constant pressure upon the posterior wall of the bladder had in the early cases a tendency to cause a protrusion as the cicatrices contracted. As a result of this the opening above the penis became larger and larger. This difficulty is met partly by groin flaps of considerable size, which closely embrace the root of the penis, and partly by means of the scrotal flap, which prevents the tissues about the opening from being drawn up as cicatrization and contraction proceed. The scrotal flap is an essential feature in dealing with the epispadias.

During the progress of the operation all the antiseptic

washes or lotions used should be warm. In dissecting up the lateral flaps great care must be taken in cases where inguinal herniæ exist.

If it be possible so to fashion the pedicles of the inguinal flaps that the external pudic arteries are not divided, a great point is gained.

Modifications of Wood's Operation.—The late Mr. Greig Smith (*Brit. Med. Journal*, Feb., 1880) made the flaps of a little larger size. The umbilical flap is in shape like the wooden portion of a fire-bellows. The portion corresponding to the handle of the bellows is uppermost and in the median line, and when the flap is turned down this portion is used to cover in the urethra, and to afford a further attachment to the tissues dissected up from the penis and scrotum.

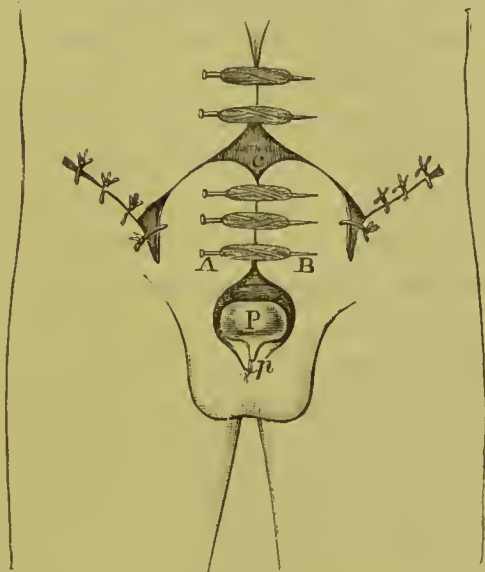


Fig. 324.—WOOD'S OPERATION FOR ECTOPIA VESICÆ.

A, B, Lateral flaps; c, Upper flap; P, Prostate; p, Penis.

The umbilical flap and the lateral flaps are secured together by means of deep quilled sutures applied in a vertical line over about the middle of each lateral flap.

Mr. Smith reports two cases, in both of which an excellent result was obtained.

Mr. Mayo Robson (*Brit. Med. Journal*, Jan. 31, 1885) reports a very successful case of Wood's operation carried out in a female child aged 8 years.

Allusion has been already made to the difficulty which arises in this procedure, of preventing some reopening of the sinus, owing to the retraction of the flaps which cover in the bladder. In Mr. Robson's case this retraction caused the bladder surface to be once more exposed in part. To meet this complication, Mr. Robson so detached the folds of

integument which formed the labia majora as to form on each side of the median line two triangular flaps which were capable of being displaced upwards. The upper margins of these flaps were attached to the lower margins of the flaps already in position.

By this means the bladder surface was entirely covered in, and only a small slit was left for the escape of the urine. This procedure should be always carried out in operating upon the female subject by Wood's method. Some excellent drawings illustrate Mr. Robson's paper.

B. Thiersch's Operation.—Two lateral flaps are formed, one to cover the lower half of the defect, and the other the upper half (*Zentralblatt für Chirurgie*, 1876, page 504). Each flap when first cut is large enough alone to cover the whole of the exposed area. From the nature of the method adopted, allowance has to be made for the shrinking of the flap. The flap first made is intended for the lower half of the bladder. It is marked out by two incisions. One commences at the upper margin of the defect, and proceeds vertically downwards to the root of the penis. The second is placed at a suitable distance to the outer side of the first, is parallel to it, and is continued down to Poupart's ligament. The flap is detached in the form of a strip or bridge, and is left connected with the body by its upper and its lower extremities. Beneath it is placed a plate of tinfoil or ivory, and for a period of three weeks its under surface is allowed to granulate. At the end of three weeks the upper attachment of the flap is divided, and it is laid transversely over the lower part of the defect. The margin of the defect will have been freshened, and to this raw border the flap is attached. The granulating surface of the flap is turned towards the bladder. (The use of granulating flaps in plastic surgery is dealt with on page 11.)

When this flap has soundly healed, and has become safely fixed in its new situation, the second flap is cut from the other side of the defect.

It is fashioned in exactly the same way, though the two parallel incisions do not extend so low down, but end at the

place of attachment of the first flap. As this flap is to be of the same size as the first, the two incisions will have to be carried higher up on the belly. The bridge of skin thus marked out and separated is allowed, as before, to granulate for three weeks.

At the end of this time its upper end is divided, and it is placed transversely over the upper half of the defect.

Its granulating surface is turned towards the bladder.

Its margins are united to the margins of the defect, which will have been freshened to receive it.

The interval between the two flaps will now be indicated by a transverse line. When the second flap is securely united, the contiguous margins of the two flaps at this line are freshened, and are secured together by sutures.

Finally, the upper margin of the second flap and the adjacent (superior) margin of the defect are freshened, and are united by sutures. If the tissues of the abdominal wall at the upper margin of the defective area be too thin for sutures, then an attempt is made to secure the closure of this final gap by granulation.

When the bladder has been covered in, the epispadias is dealt with by Thiersch's method, the details of which have been already described.

The treatment involved by this method will extend over twelve or eighteen months, and will necessitate a great number of separate operations.

The results obtained by Thiersch have been excellent.

Comment.—The special points in this admirable operation are the following:—No umbilical flap is used, on the grounds that its tissues are often so thin, scanty, and ill-nourished that some sloughing of the flap is not uncommon, and also for the reason that in the dissection of this flap the peritoneum may be injured, and a condition is provided for the production of a ventral hernia.

The injurious action of urine upon raw surfaces is prevented by the system of granulating flaps. Upon the granulating surface it seems to have no effect.

It would appear probable that a sinus would often be left

at the site of the umbilicus, but in practice this has not proved to be the case.

The flaps are not used until their vitality has been tested, until their capability of sustaining what may be termed a partly independent existence has been proved, and until they have undergone considerable contraction.

Thiersch's operation has on the whole decided advantages over Wood's method, and in its principles it is more fully in accord with those of modern plastic surgery.

Modifications of Thiersch's Operation.—Billroth adopted the following method (*Clinical Surgery, Syd. Soc. Trans.*, 1881, page 285):—"I have come to the conclusion that the best method is to dissect up two broad, lateral, doubly-pedunculated flaps, whose narrow parts lie above and below. After ten or fourteen days, when the under surface is granulating well, I unite the two in the middle line without cutting through the peduncles. If the flaps be sufficiently broad, there is no need to unite them by their outer edges; these lateral openings close spontaneously in from five to six weeks. The bladder is thus completely closed in, but an opening should be left at the umbilicus through which the urine may escape until the urethra below is completely formed; then the umbilical opening is closed, and it heals up as the urine escapes from the newly-formed passage. . . . The flaps must be very broad—that is to say, in an adult they should be at least 6 cm. broad in the middle, and about 5 cm. at the upper and lower parts.

"The flaps should be so completely detached as to overlap each other for about half their width; a sheet of tinfoil is then laid underneath them in their whole length. In a few days they approximate so much that their curved shape becomes straight; later, notwithstanding a certain amount of rigidity, they will readily unite in the middle line. A broad surface must be made by scraping away the granulations and the superficial developing epidermis from the edges."

Maury's Operation.—This method must be included among the flap methods. It was considered by the late Professor Gross to be the method best adapted for the male subject. It is a modification of the original operation by Roux, and was

described in 1871 (*Amer. Journ. of the Med. Sciences*, July, 1871):—

“A flap is taken from the perineum and scrotum by carrying a curvilinear incision from the outer third of Poupart’s ligament across the middle of the perineum to a corresponding point on the opposite side. The flap is dissected up carefully, to avoid wounding the testicles or hernia, should the latter be present, until the root of the penis is reached, when that organ is slipped through a small opening made for it in the centre of the flap, by which means the urine issues without coming in contact with the wound. A curvilinear incision is then carried across the abdomen, and a short flap dissected up for about an inch; under this the scrotal flap, its cutaneous surface having been vivified, is slid and attached by several points of a modification of the tongue and groove suture of Professor Pancoast” (Gross).

This operation is simple, but little information is forthcoming as to the success which has attended it. It has been proved that the tissues of the scrotum are not well adapted to form the substance of a principal or primary flap.

3. OPERATIONS FOR NARROWING THE DEFECTIVE AREA BY APPROXIMATING THE TWO INNOMINATE BONES.

Professor Trendelenburg, of Bonn (*Zentralblatt für Chirurgie*, Dec., 1885), is the originator of this method of treatment.

It is well known that in ectopia vesicæ the symphysis pubis is deficient, and that a gap exists between the two pubic bones, which, according to Wood, may measure from two to four inches. Trendelenburg divides the sacro-iliac synchondrosis on either side, and finds that it is then possible to bring the two pubic bones together by slight pressure. The lateral margins of the defect are freshened, and are brought together when the bones are approximated. Immediate union of the wound is aimed at. The results obtained by this operation have been striking and very satisfactory.

Trendelenburg has performed the operation in at least five cases, four males and one female.

In one case failure occurred at the first operation, but success attended the second attempt at closure.

In two instances, immediate union of the lateral walls was obtained. In only one case had the formation of flaps to be resorted to.

An excellent account of the operation, with a successful case, has been given by Mr. Makins in the *Med.-Chir. Trans.* for 1888.

Best Age for the Operation.—Trendelenburg considers that the operation should be limited to a period between the ages of two and five years, and that the latter age is the most suitable.

In the case of failure above alluded to the patient was only fourteen months old.

The Operation.—The distances between the anterior superior iliac spines and between the two pubic bones having been recorded, the patient is anæsthetised, and is turned upon the face.

An incision is made directly over each sacro-iliac synchondrosis. The average length of this incision will be about three inches.

The posterior sacro-iliac ligaments are exposed, and freely divided. The knife is then passed into the cleft, and the interosseous and superior ligaments, together with the interarticular cartilage, are severed.

The bleeding is trifling. The anterior superior iliac spines are now approximated, and the joints will then be found to gape posteriorly to such an extent as to allow the introduction of the forefinger.

The two wounds are then closed, and a drain introduced, if necessary. A suitable dressing is applied.

Extension of the joints is provided for by Mr. Makins in the following way:—

The patient is placed in a cot, and a pelvic belt on which three loops of strong webbing have been sewn is applied to the anterior borders of the pelvis. These loops are crossed as a many-tailed bandage, and are carried over the opposite side of the cot, where weights are attached to them. These weights tend to draw the ilia together.

Very great care has to be taken to prevent urine from trickling down and reaching the wounds over the articulations.

When the wounds are healed, the attempt to close in the bladder may be made.

In Mr. Makins's case nearly two months were allowed to elapse between the division of the synchondrosis and the attempt to close the defect in the bladder. By this time the exposed surface of the bladder appeared at the bottom of a more or less narrow vertical groove.

The margins of the defect are freshened and dissected up, and are mobilised as far as is required. They are then approximated by sutures in the median line. A tube is introduced into the bladder, and is retained there.

Comment.—The advantages and disadvantages of the operation are fully dealt with in Mr. Makins's paper.

It is claimed for this measure that it is simple, that it effects a great saving of time, that it may possibly be completed in two operations, and that it is very satisfactory in its results. All these points must be allowed, and the operation must take a very high position among the methods available for ectopia vesicæ.

The main objection urged against the operation is that it tends to weaken the pelvis. It is well known that the pelvis in these cases is defective, and that the waddling gait of the patient is to some extent due to the deformity of this part of the skeleton. The symphysis pubis is wanting, the ossa innominata do not come into contact in front, and to divide the posterior and almost only remaining connections of the bones would appear to prepare the way for serious weakening of the pelvic girdle. Up to the present time, however, this theoretical objection has not been found to hold good in practice. The patients operated upon have walked well after the period of convalescence was passed.

It must be allowed that although the posterior synchondroses are opened up, yet the anterior synchondrosis is to some extent restored, and the rotation of the ilia, which is a feature in these cases, is overcome.

The value of the operation can only be tested by time.

It must be remembered that the operation can only be carried out in young patients, and in female subjects it is possible that an undesirable degree of narrowing of the pelvis may result. The extent to which the joints are freed must depend upon the needs of the case. The partial separation effected in Mr. Makins's case allowed the anterior superior iliac spines to be approximated one inch in a boy aged eight. With complete freeing of the joints Trendelenburg has lessened the distance between the two spines by two inches in a child aged two and a half years.

Such entire rupture of the connection between the ilium and the sacrum should be limited to extreme cases.

Neudörfer's Operation has been the outcome of a study of Trendelenburg's method.

Neudörfer does not separate the synchondroses, but he attempts to secure immediate union of the lateral margins of the defect—after they have been duly freshened—precisely as Trendelenburg does.

He relieves tension, and renders the approximation of the margins possible, by means of two lateral horseshoe-shaped incisions, which are carried through the whole thickness of the abdominal wall, down to the fascia transversalis. These incisions are convex outwards. Before bringing the cutaneous margins together, he detaches the mucous membrane of the bladder to a sufficient extent to allow of the two sides of the membrane being united by sutures in the median line. Over this cap of mucous membrane the skin is united as already described.

The penis and urethra are displaced backwards and downwards behind the symphysis.

The pubic bones on each side have their surfaces freshened, and are brought together by sutures.

AFTER-TREATMENT OF CASES OF ECTOPIA VESICÆ.

After any operation every care must be taken to prevent the urine from coming in contact with the wound.

To effect this end, the patient should be propped up in

bed in a sitting posture, the shoulders must be well raised, a thick pillow must be placed under the knees, and the thighs should be kept drawn up by means of a bandage which passes under the knees and across the shoulders and back.

The bed should be provided with a proper macintosh, and with such a mattress that the urine can escape through a funnel-shaped opening in the centre of the bed.

Troublesome erections may be controlled by the application of ice.

The bladder should be frequently washed out with a warm solution of boracic acid, and the tube placed in the urethra should be frequently changed.

Special care will be needed to prevent the formation of bed-sores.

Mr. Parker kept his patients in a hip bath of warm boracic lotion throughout the whole of the after-treatment, with the result that almost complete primary union followed a flap operation. With care the position of the patient in a hip bath may be made so comfortable that he will rest better in the bath than in the constrained and cramped position he must of necessity occupy in bed. The discomfort of lying upon a wet macintosh is also not inconsiderable.

It is needless to say that the lotion in the bath must be maintained at an even temperature, and be constantly changed.

Thiersch and others advise the use of a compressorium after the operation has been quite completed.

This instrument is intended to occlude the newly-made urethra, and to be removed when required.

It cannot be recommended, on these grounds:—In the first place, the capacity of the new bladder is very small; and in the second place, the constant pressure of the instrument is capable of producing a slough, or even a urinary fistula.

In the most successful cases a urinal cannot be dispensed with.

RESULTS OF THE OPERATION GENERALLY.

The results claimed in the most successful cases are that the raw surface of the bladder is protected and covered in,

and that a urinal can be worn which will keep the patient quite dry. Many patients are free from the inconvenience of incontinence when they are lying down, but in no instance can it be claimed that the patient has acquired a control over the bladder. These results, however, are very satisfactory when the miserable condition of the patients before operation is considered.

In placing the circumstances of operative treatment before the patient's friends, the following facts must receive due consideration:—1. Patients with ectopia have reached old age, and have had no operation performed. 2. It may still be possible to secure an apparatus which will protect the bladder and efficiently collect the urine. 3. The treatment is tedious and painful, and may extend over many months, or over some years. In one case, as we have mentioned (page 97), treated by Billroth, no less than nineteen operations were performed. 4. The operative treatment is not without risk.

I should imagine that few operations in surgery are attended with a larger percentage of partial or complete failures than are the flap operations for extroversion of the bladder.

CHAPTER VIII.

OPERATIONS FOR ACQUIRED URETHRAL FISTULA.

THE remaining operations upon the urethra consist almost exclusively of various methods which have been adopted for the purpose of closing acquired urethral fistulæ. These operations involve no special feature of plastic surgery, and will only be very briefly alluded to.

The principal difficulty in effecting a closure of these fistulæ depends upon the fact that the wound is apt to be saturated with urine every time the patient empties the bladder.

If this difficulty can be met, the treatment of these sinuses becomes comparatively simple.

It must be assumed, in the first place, that the cause of the fistula has been dealt with. In a very large proportion of cases the sinus has followed upon stricture, and it is needless to say that no treatment of the fistula will be of avail until the stricture has been cured.

Assuming, then, that the parts have been placed in the best possible condition for healing, the difficulty incident upon the passage of the urine can be most effectually met by establishing a perineal fistula through such an incision as would be made in median or lateral cystotomy.

Through such a wound the whole of the urinary current can be diverted if a suitable tube be retained in the bladder during the healing process. The ease with which such incisions close as soon as the urine is allowed to escape once more by the urethra is well known.

If there be any objection raised to the incurring of such small risks as attend a simple cut made into the bladder, then

the surgeon must attempt to close the fistula while the urine is still passing by the natural channel.

In any such case a soft catheter must be introduced into the bladder, and must be retained there until the wound has healed. To the end of this catheter must be attached a long tube with a free lumen, whereby the urine as soon as it enters the bladder can be conducted directly to a vessel placed beneath the patient's bed.

If moderate good fortune attend the case, such a catheter may be comfortably retained for a week, and at the end of that time it may be withdrawn, the urethra washed out with some mild antiseptic solution, and a fresh instrument, if necessary, introduced.

In some instances, for one reason or another, the catheter cannot be retained. Very often it excites catarrh of the bladder or urethra, and a muco-purulent discharge escapes at the meatus. In these cases it is of little avail to persist in attempts to close the fistula, and the least risk and the least inconvenience to the patient are involved in at once establishing a temporary opening at the neck of the bladder.

The skin of the penis is not very well adapted for plastic measures. It has the advantage of being mobile, but it is at the same time very thin, and not capable of an active granulating process.

The **operations** which may be carried out in these cases are the following :—

1. The margins of the fistula may be freshened, and directly united by sutures. Any tension upon the sutures may be met either by means of lateral incisions or by freely mobilising the integument all round the seat of the abnormal opening.

2. The fistula may be closed by the process known as the method by gliding or lateral displacement. (*See page 4.*)

3. The closure may be effected by means of flaps, which may be single or double, lateral or antero-posterior.

The formation of a pedunculated flap, adjusted by means of torsion, is not well adapted for this part of the body.

The use of one reversed and two superimposed flaps has been attended with considerable success.

The general plan of such an operation is identical with that of Nélaton's operation for epispadias (page 82).

A long narrow median flap may be dissected up from the tissues immediately behind or in front of the fistula. The base of the flap would correspond with the posterior or anterior margin of the fistula.

The flap is raised and is reversed, so that its skin surface is turned towards the urethra. It is attached to the freshened margins of the defect. Over it two lateral flaps are drawn, so as to cover its raw surface and to further strengthen the shield which is made to protect the breach. These lateral flaps will be united to one another in the median line.

It will be obvious that this last-mentioned measure is susceptible of considerable variation and modification. In connection with this subject the section on hypospadias (page 89) may be consulted.

CHAPTER IX.

OPERATIONS FOR RUPTURED PERINEUM.

Anatomical Points.—In the great majority of instances the rupture for which an operation is required has occurred during labour. If the laceration extend into the rectum, and involve the sphincter ani, it is termed “complete.” If it fall short of the rectal tissues, it is described as “partial.” In carrying out the needed operation the surgeon must bear in mind that he has not merely to form a bridge of skin between the vagina and the rectum, but to restore the perineal body. The term

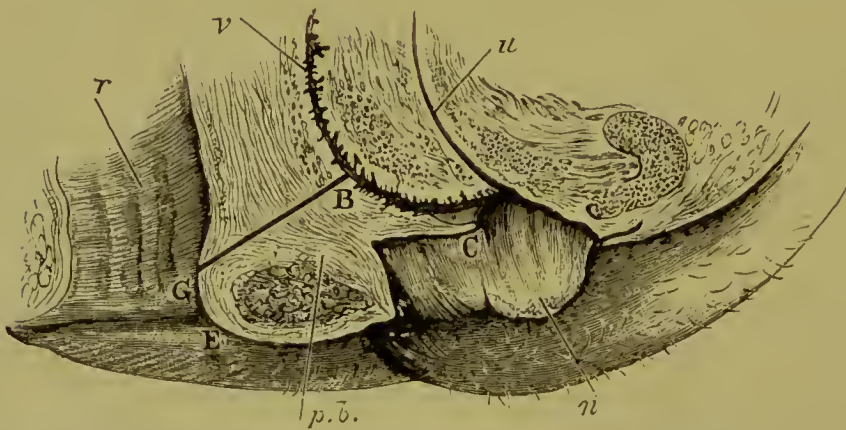


Fig. 325.—SAGITTAL SECTION OF FEMALE PERINEUM. (*Modified from Henle.*)

r, Rectum ; *v*, Vagina ; *u*, Urethra ; *n*, Nympha ; *p. b.*, Perineal body.

perineal body has been applied to the pyramidal mass of tough elastic connective tissue which is interposed between the lower ends of the rectum and vagina. It is shown in part in the accompanying figure from Henle (Fig. 325). The base of the pyramid corresponds to the skin extending between the vagina and the anus, which skin represents the anatomical perineum.

The apex is at some distance above the orifices of the two canals. It may be roughly estimated that the perineal body will measure about one inch and a quarter in height, and one inch and a half in breadth. The complete restoration of this important supporting buttress is the main feature in operations for ruptured perineum.

In the anterior part of the base of the perineal body is the central point of the perineum, at which point the sphincter muscles of both the vagina and the anus and the transverse perineal muscles meet.

When some weeks or months have elapsed after the laceration has occurred, and when the parts have well healed over, it is a little difficult at first to realise what has been the full extent of the injury, and what must be the full extent of the restoration. This is especially the case when the parts are patulous, when the mucous membrane is bulging downwards, and when the cicatrix is ill-marked.

The torn surfaces, which should be in contact, and vertically placed, are now widely separated, and are reduced to nearly the same horizontal plane. The position of the structures concerned can be best understood by comparing Fig. 325 with Fig. 327.

The raw surfaces *C B G E* and *D B G F* (Fig. 327) represent the perineal body split into two parts. The lines *C E* and *D F* were, before the accident, in the median line of the perineum. (See Henle, Fig. 325, *C E*.) They formed the raphe, and corresponded to the base of the perineal body. The apex of the perineal body is represented by the tissues along the line *B G* (Figs. 325 and 327); and the distance between *B G* on the one hand, and *C E* or *D F* on the other, will represent the "height" of the perineal body. It is not always easy at once to recognise that the central tissues about the line *B G*, which appear to continue the posterior median raphe of the vagina, and which are nearly on a level with the surrounding skin, should properly be placed at a point some inch and a quarter above the orifice of the anus and the skin of the perineum.

The pyramid forming the perineal body has been split into two, and has collapsed. The new raphe of the perineum will

be formed when the lines C E and D F (Fig. 327) are brought together, the new vaginal raphe when C B and B D are approximated, and the new rectal raphe when G E and G F are united on the median line.

Preliminary Treatment.—It is always advisable to close the rent as soon as possible after the laceration has been produced. This may be attended with success, but the success will, as a rule, be partial only.

In the most usual circumstances the rupture will be of some weeks' standing when the case comes before the surgeon's notice, and the rent surfaces will have healed over.

It is desirable that the patient be in good health, and that there be no local complications. It is very important that the rectum should be empty, and that the intestinal canal should contain as little *débris* as possible. This is ensured by a few days' dieting, by the liberal use of aperients, and by the administration of an enema on the eve of the operation.

An existing vaginal discharge should be got rid of if possible. The condition is not unfrequently complicated by piles; but unless these are of severe degree, they form no obstacle to the operation.

The parts must be very thoroughly cleansed before the operation, and any hair upon the perineum may be shaved off.

Operative Measures.—The treatment of ruptured perineum by operation dates from the time of Ambrose Paré. The procedures adopted by the older surgeons were simple enough. The torn surfaces were refreshed, and were united by sutures. In modern times innumerable modifications have been introduced. An essentially simple operation has been complicated by a number of intricate, and often ridiculous, methods. There is no form of suture designed by man that has not been tried upon the female perineum. The literature of the matter is voluminous and confusing, and is burdened with a perfect medley of ineffective terms. The subject has, in fact, been somewhat over-specialised, and the primary simplicity of the operation only becomes evident when it is freed of all such rags and tatters as do not belong to the bare elements of surgery.

The operation below described is the simplest, and, so far as my own experience goes, the best. In Dr. Parvin's article in Ashhurst's "Encyclopædia of Surgery" (vol. vi., page 688) will be found an account of some of the many different methods which are carried out in this region. The description of the operation given by Dr. Galabin, in his work on "Diseases of

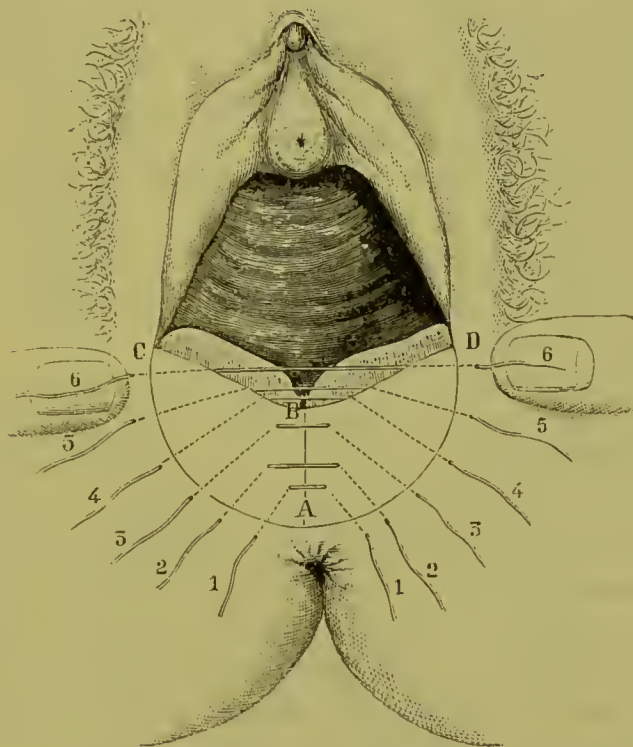


Fig. 326.—REPAIR OF RUPTURED PERINEUM. (*Galabin.*)

Women," is clear, and has been largely followed in the sub-joined account. The two figures which illustrate the operation have been derived from the same source.

Operation for Partial Rupture.—The patient is placed in the lithotomy position, and the thighs are supported by means of Clover's crutch. The buttocks are brought well up to the end of the table. The surgeon sits facing the perineum. Two assistants stand by the patient's pelvis, and each retracts the labium with one hand, while he sponges, and otherwise assists the operator, with the other.

The extent of surface to be freshened is indicated, to some degree, by the cicatrix left by the laceration. "It is well, however, to go a little beyond the limits of this in all directions, especially up the median line of the vagina, and towards the lower halves of the labia majora, both in order to secure, if possible, a perineal body somewhat larger and deeper than the original one, and to allow some margin, in case the surfaces do not unite completely up to the edges. To put the mucous membrane on the stretch an assistant at each side places one or two fingers on the skin of the thigh, and draws the vulva outwards. The skin just beneath A (Fig. 326), in front of the anus, may also be seized by a tenaculum and drawn downwards. If still the mucous membrane is not sufficiently on the stretch, from laxity of the vagina, the posterior vaginal wall, some distance above B, should be seized by long-handled tenaculum forceps and pushed upwards.

"Incisions are then made through the mucous membrane, from B to A, in the median line of the vagina, and from A to C and D, through the junction of the mucous membrane and skin (Fig. 326). These should not be extended in the direction of C and D farther than the lower extremity of the nymphæ at the utmost. There are then two triangular flaps—A B C and A B D. These are to be dissected up from the apex A towards the base B C and B D, the corner of the mucous membrane at A being seized with dissecting forceps. The dissection should not be deeper than necessary, and if it is done with the knife the surfaces are more ready to unite. If, however, there is much tendency to bleed, scissors may be used. The apices of the flaps are then cut off with scissors, leaving an upturned border along B C and B D. When the surfaces are drawn together, these borders form a slightly elevated ridge towards the vagina; and if there be any failure of union just along the edge, they fall over and cover it" (Galabin).

Silkworm gut forms the best suture material. The sutures may be most conveniently introduced either by means of a curved needle in a handle or by means of a large Hagedorn's needle held in a holder. They should be introduced as shown in Fig. 326, the dotted lines representing the buried parts of

the suture. The sutures 1, 2, and 3 may be buried along the whole length of their course. "If, however," writes Dr. Galabin "they are brought out in the centre for spaces alternately short and long (Fig. 326), the surfaces are more easily brought into contact at all levels without undue tension."

The sutures 4, 5, and 6 are brought out close to the margin along which the folds of mucous membrane, B C B D, are turned

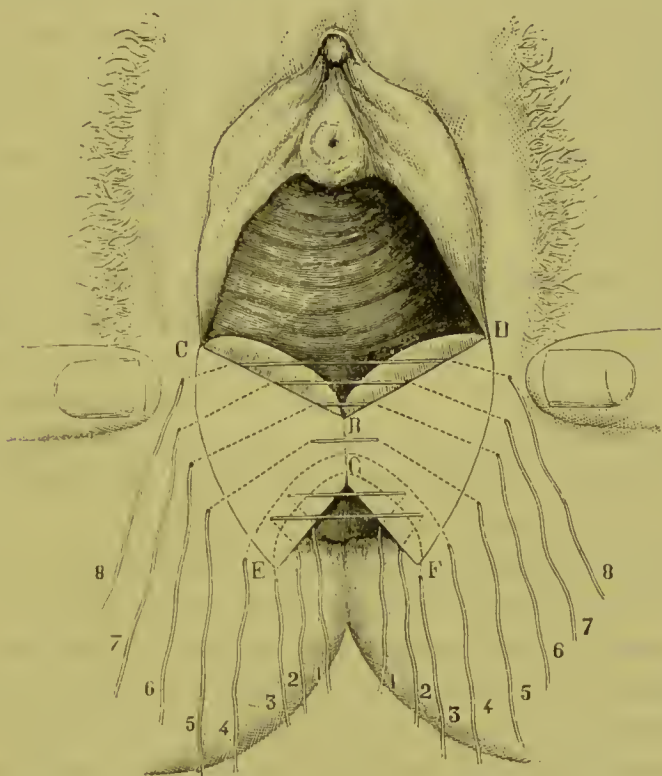


Fig. 327.—REPAIR OF RUPTURED PERINEUM. (Galabin.)

up from the vagina, and are not passed through the mucous membrane itself.

The sutures are tied in order from behind forwards—*i.e.* from No. 1 to No. 6. As they are being secured, a stream of some antiseptic solution from an irrigator should be allowed to play over the surface in order that no blood clot may be enclosed in the depths of the wound.

Operation for Complete Rupture.—The preliminary measures, already described, having been taken, the operation is proceeded with as follows:—

“ A point (B, Fig. 327) in the median line of the vagina, a sufficient distance above the apex of the rent in the septum, is taken, and an incision through the mucous membrane is made from B to G, and from G to E and F along the edges of the septum, between the rectal mucous membrane and the cicatrix. Incisions are also made through the skin from E to C, and F to D, so that the freshened surface may extend somewhat beyond the limits of the cicatrix, C or D not to be higher than the lower extremities of the nymphæ. The quadrilateral flap E G B C is then seized at E by dissecting forceps, and dissected up with the knife from the angle E, and afterwards from the angle G, towards the base B C. While this is done the parts are kept on the stretch by an assistant drawing down the skin below E with a tenaculum. The flap is then cut away with scissors, except an upturned border, which is left along B C. The flap F G B D is treated in a similar manner. If, as is usual, the ends of the sphincter at E and F have retracted from the margin of the cicatrix, it is well to cut away with the scissors a narrow strip of rectal mucous membrane, generally somewhat everted, a short distance from E and F towards G, so as to bring the freshened surface to the ends of the sphincter.

“ Sutures of silkworm gut are then applied in the following manner:—First rectal sutures, either two or three, according to the extent of the rent in the septum, are applied. These are destined to be tied in the rectum, and the ends left projecting through the anus. They are best applied with a half-curved needle held in a holder. The needle is passed in a little distance from the margin of the rent, and brought out almost at the very edge of the rectal mucous membrane, on the line G F. The needle is then threaded at the other end of the suture, and that is drawn through in the same way from without inwards on the margin E G. Next, two sutures at least are passed completely round through the remnant of the septum by means of a curved needle, not too large, mounted in a handle. This is passed unthreaded, and draws the suture back with it on withdrawal. The first of these (3, Fig. 327) is passed in somewhat behind and below the angle F, so as to take up, if possible, or at least go quite close to, the end of the

divided sphincter, and is brought out in a similar position near E. Thus, when tightened, it brings together the ends of the sphincter, drawing it into a circle; but it often brings into apposition, not so much the freshened surfaces above as the unfreshened rectal mucous membrane. This serves as a barrier to keep out fæcal matter, while the next suture (4) aids the rectal sutures in uniting the freshened surfaces. The remaining sutures (5 to 8) are passed, as shown in the figure, by a slightly-curved needle mounted in a handle, in the same way as in the operation for incomplete rupture" (Galabin).

When all the sutures are in position they are tied in the order of their numbers, and the operation is completed as in the previous account.

Lawson Tait's Operation.—When, as often happens, there still remains a thin septum between the vagina and the rectum, this method should be employed. No tissue is removed by it, and the results are excellent.

An incision is made transversely along the septum, and on either side two further incisions with their convexity inwards, so that the whole resembles the capital letter H. By steadily deepening the wound with scissors and knife, the posterior vaginal wall is displaced forwards and the anterior wall of the rectum backwards, until at last the two sides of the re-formed perineal body can be approximated by sutures which are introduced deeply into the tissues. If during the dissection the mucous membrane on either side be cut into, the aperture should be closed with fine silk sutures.

After-treatment of Cases of Ruptured Perineum.—After the operation the patient must lie in bed until the wound is sound and the sutures are all removed. This will represent a period of from fourteen to twenty-one days.

The patient should be encouraged to lie upon the side. A cradle should be placed over the pelvis, the space under the bed-clothes should be ventilated, and every opportunity be taken to change the heated and close atmosphere with which the wound must of necessity be surrounded.

It is never necessary to tie the legs together, as was the

barbarous and senseless custom at one period. No T-bandage is required. The wound is best dressed with iodoform. This may be liberally dusted over the part, the wound being left otherwise quite uncovered; or a "sanitary towel" well treated with iodoform may be worn, and the wound be supported by the soft pad of the "towel." The part should be kept throughout as dry as possible.

Opium and morphia should be avoided. Great difficulty with the bowels may result if these drugs are made use of. The following case, which came under my notice some years ago, serves to illustrate this point.

The patient was a young and nervous woman, and the rupture had occurred during her first confinement. It was complete. It was closed by operation six weeks after the birth of the child. The operation appeared to be quite successful. Silk sutures were employed. Opium was freely given. No attempt was made to bring about any action of the bowels until the eighth day, when an enormous mass of hard fecal matter was passed with intense pain, and the wound was torn open from one extremity to the other.

The urine should be drawn off as frequently as is required during the first few days by means of a catheter. The vulva must be kept scrupulously clean and dry. It may be advisable to order a vaginal douche of some antiseptic lotion to be employed every morning. The parts must be well dried after its use.

The bowels should be opened by castor-oil on the morning of the third or fourth day, assuming that they have not acted naturally before then. The sutures may be removed between the eighth and the fourteenth days.

In the case of the complete operation the perineal sutures are removed first, and the rectal sutures at a later period. The removal is in the reverse order to the introduction. A small rectal speculum will probably be required when the rectal stitches are taken out.

A note must be made at the time of the operation of the number of sutures inserted, as it is not uncommon to find, when weeks have elapsed, that one thread has been overlooked.

CHAPTER X.

OPERATIONS FOR THE RELIEF OF WEBBED FINGERS.

THIS somewhat common congenital deformity is usually symmetrical. The last two fingers are the ones which are most frequently found fused or joined together. If the web be but slightly developed, the usefulness of the hand may be little interfered with. If an operation be considered necessary, it should be carried out early—about the age of six or eight. Operations much before this period are attended with risks and difficulties which it is unnecessary to encounter. The conditions of the operation depend upon the degree of the deformity. In the most favourable cases there is merely an extension forwards between the fingers of the normal web. This membrane may be comparatively thin and wide, and allow of considerable separation of the fingers (Fig. 328). In other instances the uniting material is thick, the fingers are joined closely together, and on a transverse section of the hand the “web” would be found to be almost as thick as the fingers themselves (Fig. 329). In the most severe cases the phalanges are actually fused together, and no separation can be effected by surgical means.

Many operations have been carried out in these cases. A useful summary of them, and an excellent bibliography, will be found in Beely’s monograph in Gerhardt’s “Handbuch der Kinderkrankheiten,” 1880.

Division of the Web after a Cicatrised Hole has been Established.

Rudtorffer’s Operation.—A hole is made through the web at the root of the fingers, and about the spot where the natural web would cease. Through this hole a piece of thick silver wire,

the size of a No. 5 to a No. 8 catheter, is passed. Its ends are bent back towards the wrist, and are secured there.

In the place of the wire a solid indiarubber cord of the same or of larger size may be employed. Its ends also will be secured to a bracelet at the wrist.

The little wound suppurates and granulates, and in due course heals, just as does the hole made in the pinna for an earring. The process of healing is usually slow, and throughout the progress of the case the part must be treated with anti-

septic care. As the child will probably be running about during the treatment, the wound may easily become septic, unless every precaution is taken. I have seen a very severe and extensive degree of inflammation follow this operation in a case in which the wound became septic.

When the wound has fairly healed, the wire or cord is removed, and after a few days have

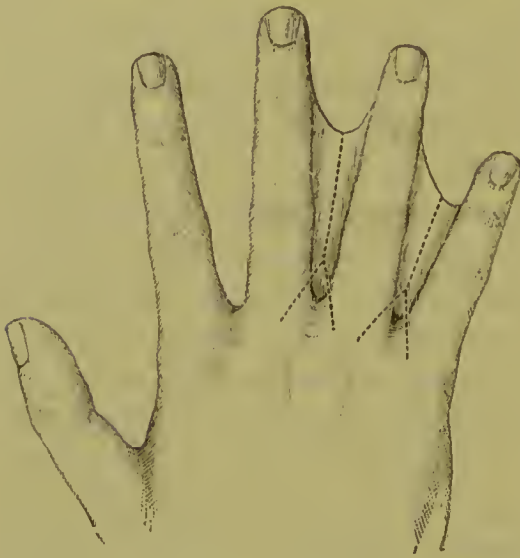


Fig. 328.—ZELLER'S OPERATION FOR WEBBED FINGERS.

been allowed to elapse the web is divided down to the cicatrised spot. The two fingers are kept well covered up and well separated during the time required for the healing of the two lateral wounds.

This method answers very well in cases where the web is thin and comparatively wide.

It was first introduced by Rudtorffer, who used a leaden thread for the purpose (*"Abhandlung über die Operation eingesperrter Brüche nebst einem Anhang,"* vol. ii., page 478, Wien, 1801).

Zeller's Operation,—This measure has undergone certain modifications since it was introduced by Zeller (*"Über d. ersten Erscheinungen vener. Localkrankht.,"* page 109, Wien, 1810):

A triangular or V-shaped flap is raised on the dorsal aspect of the root of the web. Its base will correspond to the situation of the natural web. Its apex will reach to about the first interphalangeal joint.

The flap involves not only the tissues of the abnormal web, but also a little of the skin upon the dorsum of the adjacent phalanges (Fig. 328).

After it has been marked out and dissected up, the whole of the abnormal web is divided. The apex of the flap is then drawn down between the fingers, and it is attached by sutures to the skin of the palm, a suitable raw surface having been made to receive it.

The fingers must be fixed well apart during the healing process, lest the flap be unduly compressed.

A splint composed of two metal rings—one for each finger—with an adjustable bar between them, answers the purpose very well.

There is a tendency for the tip of the flap to slough, and to meet this it must be made of sufficient length. Dieffenbach made the flap of quadrilateral outline.

In any instance it must be narrow, to avoid being compressed between the fingers.

Two triangular flaps have been cut, one on the dorsal and the other on the palmar aspect of the web, the dorsal flap being a little the longer of the two.

I have had only one opportunity of carrying out Zeller's operation, and in that instance it answered admirably. It is best adapted for cases in which the uniting tissue between the fingers is not too thick—as measured from the dorsal to the

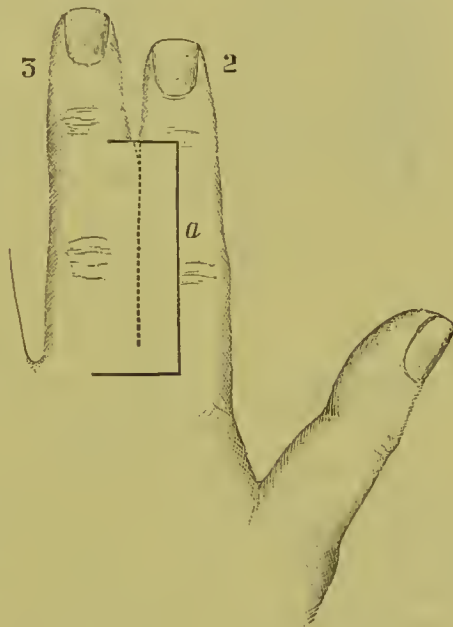


Fig. 329.—DIDAY'S OPERATION FOR WEBBED FINGERS.

palmar surface—and where the fingers are not brought into the closest contact.

Diday's Operation.—In this method two flaps are fashioned, the first from the dorsum of one finger, and the second from the palmar aspect of the other. The two flaps are adjusted after the fingers have been separated in the manner described below.

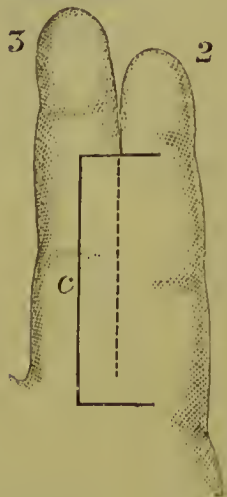


Fig. 330. — DIDAY'S OPERATION FOR WEBBED FINGERS.

This operation is called by some Didot's operation, and by others Nélaton's operation.

A description of the procedure was furnished by Didot in 1850, but it would appear that Diday has a prior claim. I have not been able to obtain access to the original paper in the *Presse Méd. Belge*, but a full abstract of Diday's (or Diaday's) paper appears in the *Journal für Kinderkrankheiten*, xv., page 470, 1850.

Two narrow quadrilateral flaps are fashioned, one on the dorsal aspect of one of the united fingers (*a*, Fig. 329), the other on the palmar aspect of the other finger (*c*, Fig. 330). These flaps must be carefully planned out. Their length will correspond to the length of the web, and their breadth to the breadth of the raw surface each flap has to cover. Each flap will be a little wider at its proximal than at its distal end.



Fig. 331. — DIDAY'S OPERATION FOR WEBBED FINGERS.

The free edge of each flap will extend up to the median line of the finger at its distal end, but will extend beyond that line at its proximal end.

The two flaps are dissected up. They must not be too thin. If, on the other hand, they are too thick, they are difficult to adjust.

When they have been well separated, the remaining tissue which unites the two fingers is divided.

The dorsal flap from the one finger covers the raw surface on the palmar aspect of the other, while the palmar flap taken from this latter finger covers the raw surface left on the dorsum of the first-named finger. (*See Fig. 331*; the letters *a* and *c* and the figures 2 and 3 correspond throughout.) The flaps are fixed in position by fine sutures.

This operation may be carried out in cases in which neither of the former methods is applicable. The procedure is difficult, and requires infinite care in its performance. The most probable fault will be the fashioning of flaps which prove when adjusted to be too narrow towards their proximal extremity.

Part VIII.

OPERATIONS ON THE NECK.

CHAPTER I.

TRACHEOTOMY AND LARYNGOTOMY.

I.—TRACHEOTOMY.

Anatomical Points.—The trachea in the adult is about four and a half inches in length. It is surrounded by an atmosphere of lax connective tissue, which allows a considerable degree of mobility to the tube. The mobility of the trachea is greater in children than in adults. The length of the trachea in the neck is not so considerable as may at first sight appear, and, according to Holden, not more than seven or eight of the tracheal rings (which number sixteen to twenty in all) are to be found above the manubrium sterni. The distance between the cricoid cartilage and the sternal notch varies greatly, and depends upon the length of the neck, the age of the patient, and the position of the head. If two inches of the trachea are exposed above the sternum when the head is erect, then in full extension three-quarters of an inch more of the windpipe will, as it were, be drawn up into the neck. According to Tillaux, the average full distance between the cricoid cartilage and the sternum is in the adult about two and three-quarter inches (7 cm.). The full distance in a child between three and five years is about one inch and a half (4 cm.); in a child between six and seven, about two inches (5 cm.); and in children between eight and ten years, about two inches and a quarter (6 cm.). The effects of growth, and of the position of the head, upon the position of the cricoid cartilage have been shown

by Symington in his work on the "Anatomy of the Child." In a child about two years of age the lower border of the cricoid cartilage is opposite the upper border of the sixth cervical vertebra when the head is acutely flexed, and opposite the upper border of the fifth vertebra when it is extended. At birth the lower border of the cricoid cartilage corresponds with the lower border of the fourth cervical vertebra, between the age of six and twelve months it is opposite to the upper border of the fifth vertebra, at five years it corresponds to the upper border of the sixth vertebra, and in the adult to the upper border of the seventh.

Symington confirms the statement by Allan Burns that in a child twelve months old the distance from the hyoid bone to the sternum is equal to the breadth of three fingers; and if these be placed in front of the neck, one finger would cover the larynx, half a finger the isthmus of the thyroid body, and a finger and a half the space between the thyroid body and the sternum; while if the head be extended, the latter space would be increased to the breadth of two fingers.

With regard to the diameter of the trachea, and the size of the tube, the following table is founded upon the observations of Symington and Guersant. (See Fig. 332.)

AGE.	DIAMETER OF TUBE.
Under 18 months	4 mm.
1½ year to 2 years	5 mm.
2 years to 4 years	6 mm.
4 years to 8 years	8 mm.
8 years to 12 years	10 mm.
12 years to 15 years	12 mm.
Adults	12 mm. to 15 mm.

The *relations of the trachea* are considered in the section which follows.

The Site of the Operation.—The operation is said to be "high" or "low," according as the trachea is opened above or below the isthmus of the thyroid body. In the adult the isthmus crosses the second and third rings of the trachea, and sometimes even the fourth. In the child the isthmus is narrow,

and is usually somewhat higher up. It may even lie on the crico-tracheal membrane (Parker). The high operation is always to be preferred; it alone is described in the account which follows (v and vi, Fig. 333).

In cutting down upon the trachea in the middle line of the neck, from the cricoid cartilage to the sternum, the following parts are met with:—Beneath the integument lie the anterior jugular veins. As a rule these veins lie some little way apart on each side of the median line, and do not communicate, except by a large transverse branch which lies in the inter-fascial space at the upper border of the sternum. Sometimes there are many communicating branches in front of the tracheotomy district, or the veins may form almost a plexus in front of the trachea, or there may be a single vein which will follow the middle line. Then comes the cervical fascia, enclosing the sterno-hyoid and sterno-thyroid muscles. Above the isthmus a transverse communicating branch between the superior thyroid veins

is sometimes found. Abnormal branches of the superior thyroid artery may cross the upper rings of the trachea. Over the isthmus is a small venous plexus, from which the inferior thyroid veins arise; while below the isthmus these veins lie in front of the trachea, together with the thyroidea ima artery (when it exists). The inferior thyroid vein may be represented by a single trunk occupying the middle line.

In the infant before the age of two years the thymus extends up for a variable distance in front of the trachea. At the very root of the neck the trachea is crossed by the innominate and left carotid arteries, and by the left innominate vein.

Advantages of the High Operation.—The anterior jugular veins are smaller here, and transverse branches are rare.

The muscles which are in close contact below diverge a little

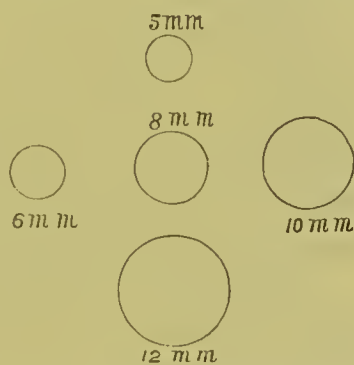


Fig. 332.—SECTIONS OF TRACHEOTOMY TUBES: SHOWING THE EXACT DIAMETERS, EXPRESSED IN MILLIMETRES.

as they ascend. The great vessels are not in danger, the inferior thyroid vessels and the thyroidea ima are avoided.

The trachea is nearer the surface, is more fixed, and is much more readily exposed.

Disadvantages of the Low Operation.—The anterior jugular veins are larger, and transverse branches are common.

The muscles are in closer contact. The inferior thyroid veins and thyroidea ima are readily wounded. The great vessels and the thymus may be exposed to danger.

The trachea is much deeper, is more mobile, and is exposed with difficulty.

To these disadvantages Mr. Jacobson adds the following objections:—In the low operation (1) pus is more easily conducted into the mediastina; (2) broncho-pneumonia is more probable when the wound is low down in the trachea; (3) the suction action of the chest can more readily draw the tube into the wound when the incision is near to the thorax.

Instruments required.—Scalpels; dissecting, artery, and pressure forceps; toothed forceps (Liston's artery forceps without the catch answer the purpose); sharp hook; blunt hook; seissors; needles; tracheotomy tubes and tapes. To these may be added a gag and tongue forceps, small wound retractors, and feathers to clear the tube when first introduced.

A good tracheotomy tube should be of simple construction, should be easy to introduce, should be as large as the diameter of the trachea will admit, should lie exactly in the long axis of the windpipe without touching the tracheal wall with its extremity, should have a movable shield so that it is disturbed as little as possible, and the inner cannula should be capable of being easily inserted and removed.

Mr. Durham's well-known tubes are in all respects admirable, but care must be taken that no segment of the lobster-tail cannula is loose.

THE OPERATION:

The patient is anæsthetised with chloroform.

1. **Position of the Patient.**—The child is enveloped in a thin macintosh sheet, and is placed close to the right edge of

the table. The surgeon stands by the same side of the table. The neck is supported on a firm sand-bag of suitable size. When the child is ready the head should be drawn well over the upper end of the table, so that the vertex is turned nearly towards the ground.

The sand-bag will be placed close to the upper edge of the table, and over it the child's head is extended in this extreme manner.

This position renders the structures on the front of the neck tense, steadies the trachea, draws as much of that tube up into the neck as is possible, and brings it a little nearer to the surface. The superficial veins are, moreover, a little emptied of their blood by this attitude of over-extension.

The anæsthetist stands at the head of the table, and the important duty should be imposed upon him of holding the head steady, and of keeping the chin most rigidly in a line with the sternal notch. If the head be allowed to fall over to one or other side, the position of the middle line is lost.

An assistant stands by the side of the anæsthetist, and will, later, take charge of the sharp hook.

A second assistant, with sponges, etc., will take his place to the left of the table—*i.e.* to the surgeon's right.

2. Exposing the Trachea.—An incision is made with a sharp scalpel very precisely in the median line of the neck. Its length will be about one inch or an inch and a half, and its upper extremity will be at the upper border of the cricoid cartilage. Before making this cut, the surgeon should have accurately defined the position of the thyroid and cricoid cartilages. The latter cartilage is often difficult to detect in stout subjects, and especially in young infants.

The skin and the trachea are steadied with the left hand while the cut is being made.

The right hand must be unsupported. If the operator rests his wrist upon the upper part of the child's chest, as he is tempted to do, he will find that the rapid movements of the thorax in laboured breathing render that part no proper place for support.

The surgeon, still fixing the trachea and soft parts with

the left hand, cuts deliberately in the middle line through the subcutaneous fat and the anterior layer of the cervical fascia. The sterno-hyoid and sterno-thyroid muscles are reached, and the interval between them is opened up. All this is done by successive clean cuts.

The surgeon now separates the muscles, using the dissecting forceps and the handle of the scalpel for the purpose.

Keeping still to the middle line, and once more steadying the trachea, he divides cleanly, and by cautious cuts, the fascia covering that tube.

At this stage veins will probably be encountered, and may be displaced to one or other side by the handle of the scalpel. The isthmus of the thyroid will be seen, and is by a like means displaced downwards. If necessary, it may be drawn and held downwards by a small blunt hook.

The surgeon now feels for the tracheal rings with his left forefinger. He should be satisfied that the tube is well bared, and he should be able to see the white rings themselves.

3. Opening the Trachea.

—A small sharp hook is now introduced into the cricoid cartilage, and is given to the assistant to hold who stands at the head of the table.

The hook is kept precisely in the middle line, and is used to fix and draw forwards the cricoid cartilage, and to render the trachea tense. The assistant must give a little play to the hook, as the larynx moves with each inspiration.

With the left forefinger the operator feels the upper rings of the trachea, and with a slender scalpel, held with the edge

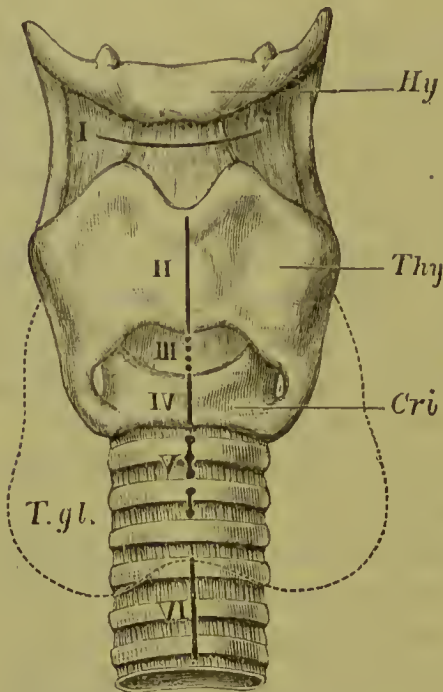


Fig. 333.—OPERATIONS ON THE LARYNX AND TRACHEA. (Tillmans.)

I, Sub-hyoid Pharyngotomy; II, Thyrotomy; III, Laryngotomy; IV, Cricotomy; V and VI, High and low tracheotomy; Hy, Hyoid bone; Thy, Thyroid cart.; Cri, Cricoid cart.; T. gl, Thyroid gland.

towards the patient's chin, he stabs the trachea in the median line some three rings below the cricoid, and cuts up on to the hook (v, Fig. 333).

The noisy rush of air entering and escaping through the wound, the coughing of the child, and the expulsion of mucus and membrane bring about a moment of confusion. The hook must not be removed. It remains as an easy guide to the median line of the trachea and the site of the opening therein. The opening must be free.

If the hook be not used, the operator may miss the slit in the trachea he has already made, and may, in his haste, proceed to make another.

4. Introduction of the Tube.—The right margin of the cut in the trachea should be lightly seized with the toothed forceps, which are held in the left hand; and while the opening is thus for a moment demonstrated and fixed, the tube and pilot are slipped in. If the forceps be employed as directed, the tube can be introduced with certainty and ease. If no such precaution be taken, much time may be wasted in driving the pilot hither and thither in search of the slit-like opening, which is very easily lost. The depth of the wound, the quantity of blood and mucus which may fill it, and the movements of the trachea, may readily cause the site of the opening to be lost, especially if the trachea has not been well exposed, and the fascia freely divided.

It will usually be found more convenient to restore the child's head to the erect position before the tube is introduced. When the tube is in place—and not before—the sharp hook is removed.

The tube is secured in place by tape, and the wound below the tube is brought together by a suture or two of silkworm gut. A piece of lint properly shaped and smeared with a weak iodoform ointment is placed under the shield of the tube, and is made to cover and protect the wound.

Rapid and efficient sponging with small pieces of fine Turkey sponge is of great service throughout the operation.

5. Detachment of Diphtheritic Membrane.—Mr. Parker advises that before the tube is inserted an attempt should

be made in all cases of diphtheria to rid the trachea of false membranes and retained secretions. This he accomplishes by means of a long feather which has been dipped in the following solution :—Bicarbonate of potash or soda, $\mathfrak{z}\text{ij}$; glycerine, $\mathfrak{z}\text{j}$; water, $\mathfrak{z}\text{x}$. The feather is passed into the windpipe, and is twirled about so as to detach the membrane as completely as possible. Some is withdrawn, some is coughed up. The feather may be also passed up into the larynx and through the glottis.

This potash solution is said to dissolve and detach the secretions.

TRACHEOTOMY BY BOSE'S METHOD.

This method—often termed the bloodless method—is extensively practised in Germany.

A vertical incision is made in the median line. It commences opposite the centre of the thyroid cartilage, and is continued downwards for about one and a half or two inches. The incision is carried down to the lower part of the thyroid cartilage and the upper part of the cricoid. The soft parts being held aside by retractors, a transverse incision is made along the upper border of the cricoid cartilage in such a way as to divide the layer of the deep cervical fascia which lies in front of the trachea and which holds the thyroid isthmus. A



Fig. 334.—HOOK USED FOR DRAWING DOWNWARDS THE THYROID GLAND IN TRACHEOTOMY, ETC.

blunt director is now introduced through this transverse incision, and by its means the fascia and the isthmus, together with all the veins con-

nected therewith, are fully separated from the trachea. A broad, curved hook (Fig. 334) is now introduced, and the detached fascia, together with the other soft parts, is drawn downwards, leaving the trachea quite bare. The cricoid cartilage is now fixed by means of a double-pointed sharp hook, and the tracheal rings are incised in the usual way.

This method has much to commend it. It is simple and easy of performance. It involves some expenditure of time,

and some damage may be done to adjacent structures by the director if care be not used. Veins are readily torn through by this instrument. If cautiously performed, the operation has distinct claims to be called "bloodless."

The procedure has been modified by Mr. Whitehead (*Lancet*, April 30, 1887), who carries out the tracheotomy as follows:—An incision is made in the usual situation, but of rather greater length than is common. The incision extends through the skin and fascia, as deep as the interval between the sterno-hyoid muscles. The scalpel is now laid aside, and the raspatory used, not only to separate the sterno-hyoids, but to split the strong fascia which runs down from the hyoid bone to enclose the isthmus of the thyroid gland. This fascia is split to a distance extending from the upper limit of the incision down to the isthmus below—that is, supposing it is desired to open the trachea above the isthmus. The split fascia is then pushed to right and left with the raspatory. Should there be any difficulty in doing this, the fascia is separated to some extent on each side from the upper border of the isthmus. Proceeding carefully, the isthmus itself can be pushed down and the trachea exposed to the necessary extent. If the trachea is to be opened below the isthmus, the procedure is similar—remembering that here, however, there is between the fascia and the trachea a quantity of areolar tissue, in which lies the inferior thyroid plexus of veins. The front of the trachea can in this way be cleared perfectly, and, since the method is bloodless, the rings of the tube are seen glistening white at the bottom of the wound. What is urged in favour of the operation is—firstly, the ease with which it can be performed; secondly, the small number of instruments required; and, thirdly, the manner in which it meets the four difficulties usually enumerated—viz. of reaching the trachea, of hæmorrhage, of opening the trachea, and of introducing the cannula. Again, it avoids in an especial manner those dangers met with when the operation is performed, as it too often is, practically in the dark—from the bleeding, and the insufficient separation of the parts; thus it is impossible, in this operation, that the cannula should be pushed down between the trachea and the fascia lying in front of it,

or that it should be thrust, as has actually happened, into the internal jugular vein.

Comment.—The operation, as here described, has been considered in connection with its most common surroundings—namely, with the operation urgent, and the patient a young child struggling against suffocation.

As an operation *quâ* operation, tracheotomy must be regarded as an easy and simple procedure. Those who have performed it only upon the dead subject must be at a loss to understand the terrible possibilities with which the introduction of a tracheotomy tube appears to be surrounded. In the adult, it is true, the operation is but rarely in any way difficult or complicated; in an infant with a short stout neck, on the other hand, it may be attended with not inconsiderable difficulties.

For the accidents which so often occur during tracheotomy the hurry and excitement of the operation, and the fear that the child is ceasing to breathe, are in the main answerable, and not the anatomical conditions of the operation itself.

Tracheotomy affords a striking illustration of the adage “The more haste the less speed.” The surgeon who proceeds to open the trachea in a precise and deliberate way will have completed the operation before the frantic man who, with palpitating heart and a trembling hand, cuts wildly towards the spine, and who appears to be actuated by the unsteady conviction that he must gash something or the child will perish. Artificial respiration may be relied upon to restore a patient who has ceased to breathe for some seconds, provided that the tube has been introduced without complication, and that the cessation of respiration does not depend upon uncontrollable conditions. The operation must be systematically done. The surgeon who seeks to be brilliant at this operation may be at once regarded as dangerous.

A child's trachea is very mobile, and it is marvellous to note the ease with which it may be made to collapse on pressure. To the finger roughly introduced the infant's trachea offers little resistance, and its mobility is such that it has been

held aside unknowingly by retractors, while the operator is scoring the œsophagus (Durham).

The tracheal rings are very soft, and with a sharp scalpel little force is required to divide them.

I know an instance in which a young operator, in his anxious hurry, slit up the upper tracheal rings, together with the whole larynx, the knife only stopping at the hyoid bone.

The flimsiness of the infant's trachea cannot be too fully realised. I have seen a portion of the wall of the trachea bent upon itself, and forced by the pilot into the lumen of the windpipe. The opening in this instance was small, although it was found that the trachea had been incised in more than one place.

In young infants, and in children generally, care should be taken that the cricoid cartilage is not severed. If it be divided, the tube is found to be placed so near to the larynx as to produce undue irritation of it.

In children the isthmus of the thyroid body is small, may be disregarded, and may be safely divided if the section be in the median line. In adults it is readily recognised, and easily drawn downwards out of danger.

It must be expected that in almost every case there will be free venous bleeding. While it is well that the hæmorrhage should be checked before the tube is introduced, lest blood find its way into the lung, yet too long a time should not be devoted to attempting to secure the vessels. As soon as the tube is introduced, air enters the lung more freely, the right side of the heart is relieved, and venous bleeding, which before was very copious, ceases almost immediately.

The cervical fascia must be well and cleanly divided. The tube has many a time been introduced between the trachea and the imperfectly divided fascia, the operator being under the impression that it has been inserted into the windpipe. No air, however, escapes.

In cases where an extensive membrane exists, it may escape division when the trachea is opened, and the tube may then be inserted between the membrane and the tracheal wall. In this case, also, no air escapes from the instrument.

In most cases of tracheotomy performed by a novice, or carried out with undue haste, it will be observed that the time of the operation is more fully taken up by introducing the tube than by finding and incising the trachea.

If the hook and the toothed forceps be used as described, all bungling over the insertion of the tube may be avoided. Some time may be spent in endeavouring to find the slit which has been already made in the trachea.

No director is required in this operation, nor are the various dilators which have been devised really necessary, although they may be of use when much membrane has to be cleared away.

Some General Rules in Tracheotomy.—1. Let the chin be kept rigidly in a line with the sternal notch.

2. Cut only in the middle line.

3. Avoid anxious assistants with retractors.

4. See the white rings of the trachea, and feel them bare before plunging the knife into the windpipe.

5. Avoid hurry.

After-treatment.—This will obviously depend a great deal upon the nature of the case. The after-treatment of a case of tracheotomy performed for impacted foreign body will of necessity differ greatly from that performed for diphtheria. The period at which the tube has to be removed can never be decided in an arbitrary manner. It should be taken out at the earliest possible period. In a case of œdema of the glottis from scald it may be possible to discontinue it at the end of twenty-four hours, while when tracheotomy has been performed for a laryngeal growth, the tube may have to be worn during the remainder of the patient's life.

In a child, the sooner the rigid metallie cannula can be replaced by an indiarubber tube the better, especially if it be necessary to keep the tracheal sinus open for a prolonged period.

There is often much difficulty with children in getting them to take sufficient food; and if this difficulty be not readily overcome, it is well that the child should be fed, for a while, by means of a small Jaques's catheter passed down into the œsophagus through the nose.

With regard to the steam tent, or "croup bed," and the measures to be adopted to keep the tube clean, I cannot do better than quote the excellent and practical observations of Mr. Jacobson upon this head:—

"While fully aware of the need of moisture when the atmosphere is dry, when the membrane tends to crust and become fixed, I am of opinion that the unvarying rule of cot-tenting and use of steam is disadvantageous. The weakly condition of children with membranous laryngitis, and all they have gone through, must be remembered. Believing that such seclusion, and so little admission of air, tend to increase the asthenia, and any tendency to sepsis, I much prefer to be content to keep off draughts by a screen, which allows of the escape of vitiated air above, using steam, if needful, according to the size of the room, fireplace, etc., and according to the kind of expectoration, whether easily brought up by the cough or feathers, or viscid, quickly drying, and causing whistling breathing. If the temperature can be otherwise kept up to 60° or 65°, I much prefer to use a thin flat sponge, often wrung out in a warm solution of boracic acid. The inner tube must be frequently removed and cleansed, every hour or two at first. If the secretions dry on and cling to it, they are best removed by the soda solution mentioned below. At varying intervals between the removal of the tube, any membrane, etc., which is blocking it, appearing for a moment at its mouth and then sucked back, must be got rid of by inserting narrow pheasant feathers, and twisting them round before removing them. If the exudation is slight, moist, and easily brought up by cough or feather, sponging or brushing out the trachea is not called for, but should be made use of when there is much flapping, clicking, or whistling of the breathing; and if this is harsh, dry, or noisy, instead of moist and noiseless, two of the best solutions are sodæ bicarb., gr. v-xx to aq. ʒj, or a saturated one of borax with soda. These may be applied by a hand or steam spray over the cannula for five or ten minutes at a time, at intervals varying according to the relief which is given, or applied with a laryngeal brush, feather, or bit of sponge twisted securely into a loop of wire. When any of these are used, the

risk of excoaration and bleeding, and the fact that only the trachea and large bronchi can be cleaned, must be borne in mind ; and with regard to manipulations for cleansing the trachea and removing the inner tube, it is most important to remember that the caretaking may be overdone, and a weakly child still further exhausted by meddlesome interference."

II.—LARYNGOTOMY.

Laryngotomy or the artificial opening of the larynx through the crico-thyroid membrane, is occasionally performed as a substitute for tracheotomy. The operation has the advantage of being very rapidly and very easily carried out. It is quite inapplicable to children under thirteen years of age, owing to the narrowness of the crico-thyroid space. The great drawbacks of the operation are the proximity of the vocal cords and the difficulty of adjusting a suitable tube. Laryngotomy is totally unsuited for cases in which a tube has to be long worn.

The vertical height of the crico-thyroid space in the well-developed adult subject is only about half an inch.

The crico-thyroid arteries cross the space, but are usually of quite insignificant size. Occasionally they are large, and Mr. Durham states that "cases are recorded in which serious and even fatal hæmorrhage has occurred from these vessels."

For the general surroundings of the operation, the instruments required, the special precautions to be taken, and the after-treatment, the reader is referred to the section on Tracheotomy.

The Operation.—The head is well extended over a sand-bag or hard cushion, and is kept fixed, with the chin in a line with the sternal notch. The anæsthetic selected is chloroform. The anatomical details of the part must be made out, and the crico-thyroid space defined (III, Fig. 333).

The larynx is lightly steadied with the left hand, while the surgeon makes a vertical median incision, about an inch and a quarter long, over the lower part of the thyroid cartilage, the crico-thyroid space, and the cricoid. The fascia having been divided, the interval between the sterno-thyroid and

crico-thyroid muscles is appreciated, and is widened with the handle of the scalpel.

The crico-thyroid membrane is exposed, and is divided horizontally, just above the cricoid cartilage.

Care must be taken that the air-passage is well opened, as it is not difficult to pass the tube downwards between the crico-thyroid membrane and the mucous lining of the windpipe.

The laryngotomy tube is shorter than that used for tracheotomy, and is oval on section.

Some surgeons advise that the membrane be opened by a vertical incision, on the grounds that the operation can, if desired, be extended by dividing the cricoid cartilage, and that in the horizontal incision damage is usually inflicted upon the crico-thyroid muscles, and possibly also upon the lateral crico-arytenoid muscles.

Suprathyroid Laryngotomy.—This operation, which is sometimes called sub-hyoid pharyngotomy, has been on a few occasions employed for the removal of growths situated at the upper opening of the larynx, and particularly of such as are connected with the epiglottis. The operation is simple, but even in the adult it rarely affords sufficient access for the efficient use of instruments (1, Fig. 333).

It was first suggested by Malgaigne (*Manuel de Méd. Opérat.*, Paris, 1835), and first carried out by M. Prat (*Gaz. des Hôpit.*, No. 103, page 849, 1859).

Solis-Cohen (Ashhurst's "Encyclopædia of Surgery," vol. v., page 735) has collected six examples of the operation for the removal of tumour. Three of these died within a few days of the operation.

A transverse incision is made through the thyro-hyoid membrane, parallel and close to the lower border of the hyoid bone. The skin, the fascia, the sterno-hyoid muscles (in whole or in part), the thyro-hyoid membrane, and the mucous membrane, are divided in order.

The epiglottis is at once exposed, and is drawn through the wound. The growth having been dealt with, and the bleeding checked, the wound is closed. The vessels

wounded are few and insignificant, and the incision heals quickly.

Infrathyroid Laryngotomy.—This operation has been carried out for the removal of growths situated on the under aspect of the cords or below the cords. Laryngotomy is performed some days before the attempted excision is made. Later, the crico-thyroid space is well opened up, and the cartilages separated to the utmost. Through the space thus obtained the growth is removed. Suitable forceps, etc., are required, and the site of the operation must be illumined by a mirror and a good concentrated light.

Thyrotomy.—By thyrotomy is understood the division of the thyroid cartilage in the median line, so as to gain access to the interior of the larynx. The operation is carried out for the purpose of removing certain laryngeal growths, and certain large or impacted foreign bodies, especially such as have found their way into the ventricles (II, Fig. 333).

The operation involves a great danger of permanently interfering with vocalisation, and in the treatment of morbid growths it is only employed when the intralaryngeal method of removal cannot be effectually carried out.

Thyrotomy offers a rapid and ready means of entirely eradicating laryngeal growths, and those advantages may be claimed for it which are ascribed to other radical operations.

The Operation.—The head is extended over a hard cushion or sand-bag, and is firmly held with the chin in a line with the sternal notch. The shoulders are raised. Chloroform is the anæsthetic administered. A preliminary laryngotomy or tracheotomy is carried out. The position of the opening for the tube will depend upon the nature of the case, the length of time the tube will probably have to be worn, and upon other circumstances. If the operation threatens to be extensive, as in dealing with large growths, a tracheotomy will be found to be the more convenient; but in such an operation as is carried out for the removal of a foreign body, a laryngotomy may be selected.

If much hæmorrhage is anticipated, as will be the case in

dealing with extensive papillomata, the trachea must be plugged. This may be effected by a tampon, such as Trendelenburg's tracheotomy tampon, or by gently plugging the trachea on either side of the tube with a piece of fine sponge properly shaped and attached to a long silk thread.

The incision is prolonged upwards in the median line, and the skin and subcutaneous tissues are divided down to the cartilage. The incision will extend over the cricoid and thyroid cartilages, the crico-thyroid space, and some part of the thyro-hyoid space.

The thyroid cartilage is divided accurately and carefully in the median line, the thyro-hyoid and crico-thyroid membranes being also cut if needed.

The division of the cartilage should be effected from above downwards, and from without inwards. In young subjects, and in females who have not passed middle life, the section may be accomplished by a small but stout knife. In aged subjects, in whom the cartilage will be calcified, a fine saw may be needed to effect a division. Bone forceps should never be employed.

In one case, in a woman about forty or forty-five, I had a difficulty in severing the cartilage with a knife, but found the division to be easily and precisely effected by using a pair of Salmon's pile scissors.

By means of two small sharp hooks the two alæ are now drawn aside, and the interior of the larynx is exposed. In old subjects it may be necessary to make transverse incisions in the crico-thyroid and thyro-hyoid membranes, close to their respective cartilages, before the fullest view desired can be obtained.

The foreign body may now be extracted or the growth removed.

In dealing with papillomatous masses, the bulk of the growth may be crushed off with broad forceps, and the remainder removed with scissors, aided by Volkmann's spoon. The surface left by the removal of the tumour may then be touched with a saturated solution of chromic acid.

Finally, the two portions of the thyroid cartilage are united

by two or three fine tendon sutures, and the wound in the skin is closed.

The after-treatment will, with obvious modifications, be conducted upon the lines observed in dealing with cases of tracheotomy.

The results of thyrotomy in malignant disease are alluded to in the section (page 158) on the Results of Excision of the Larynx.

CHAPTER II.

EXCISION OF THE LARYNX.

THE term Laryngectomy has been applied to this operation. It involves the removal of either the whole of the larynx (complete excision), or of a considerable portion of it—usually one-half (partial excision).

The first complete excision of the larynx was performed by Dr. Patrick H. Watson in 1866, for stenosis of the larynx due to syphilis. The patient, a man aged thirty-six, died in three weeks (*Trans. Internat. Med. Congress*, vol. iii., page 255, 1881).

The first complete excision for carcinoma, and the second operation in point of time, was carried out by Billroth in 1873 (*Archiv f. klin. Chirurg.*, bd. xvii., page 343). Death took place from recurrence in seven months.

The first unilateral or partial excision was performed by Billroth in 1878, for carcinoma of the left side of the larynx.

Excisions of the larynx have since these dates been very frequently carried out, principally by German surgeons.

Solis-Cohen ("Ashhurst's Encyclopædia of Surgery," vol. v., page 757, 1884) has collected ninety cases of complete excision of the larynx. Eighty were performed for carcinoma, four for sarcoma, one for lympho-sarcoma, two for papilloma, one for lupus, one for perichondritis, and one for cicatricial stenosis.

It will be seen that these operations are practically limited to cases of malignant disease.

One of the most complete and practical papers upon the operation is that by Hahn (Volkmann's *Sammlung*, No. 260, 1885).

COMPLETE EXCISION.

Preliminary Tracheotomy.—This should be carried out at least one or two weeks before the excision is attempted.

The advantages of such a step are these :—The patient will get accustomed to breathing through an artificial opening.

He will breathe more freely. He can be more conveniently anæsthetised. The trachea will become adherent to the integument, and will need no artificial support to prevent its descent when the larynx is severed from it. A little of the time of the operation will be saved.

A tracheotomy carried out some time before the excision is especially called for when the patient has much dyspnœa or dysphagia, and has suffered much loss of strength.

Plugging the Trachea.—After the patient is anæsthetised, and before the actual excision is commenced, some means

must be taken to prevent the entrance of blood into the air-passages. This is most surely effected by some form of tampon.

The well-known tampon of Trendelenburg is the one usually employed. Semon's modification of this tampon has some advantages over the original instrument (Fig. 335).

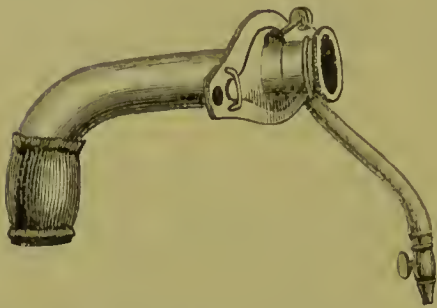


Fig. 335.—SEMON'S MODIFICATION OF TRENDLENBURG'S TAMPON-CANNULA.

Certain objections have been urged against these cannulæ.

It is said that the sac may give way; that the indiarubber of which it is made, becoming slippery, may cause the tube to slide up in the trachea; and that the windpipe is not always efficiently plugged. The first objection cannot be sustained if care be taken to test the air sac, if the indiarubber employed be new, and if it be freshly applied for every operation. With regard to the two other objections, I have personally never met with the inconveniences named in using this tampon in the ordinary run of surgical cases. The air sac must fill the trachea well. Mackenzie states that if the sac or air belt be too fully or too suddenly distended, an asthmatic paroxysm may be produced. In a case published by Mr. Henry Morris (*Clin. Soc. Trans.*, vol. xx.) the tampon had to be given up on this account.

Hahn's tampon-cannula is preferred by many (Fig. 336). It is thus described by Mr. Butlin:—"It consists of an inner and an outer tube. The inner is much longer than the outer,

Fig. 336.—HAHN'S TAMPON-CANNULA.

The Operation.—The patient lies upon the back, close to the right border of the table. The shoulders are raised, and the head is well extended over a hard cushion or sand-bag. The surgeon stands on the patient's right. The chief assistant takes his place at the head of the couch and close to the surgeon's left. An incision is made in the median line from the centre of the thyro-hyoid membrane to the second or third ring of the trachea. At the upper end of this incision a transverse cut is made which is carried outwards on either side sufficiently far to reach the sterno-mastoid muscles.

The flaps thus marked out are turned back. Some division of the fibres of the sterno-mastoid muscles may be necessary.

The vertical incision should go down to the thyroid and cricoid cartilages and the trachea.

The superior thyroid arteries may, if thought fit, be dealt with at this stage. They should be secured by two ligatures, and then divided between them. The vessels would be sought for at the posterior margin of the thyro-hyoid muscle, close to the upper border of the thyroid cartilage.

The inferior thyroid arteries may be exposed and dealt with in the same manner as they turn forwards at the lower margin of the larynx. They should be sought beneath the posterior edge of the sterno-thyroid muscle.

The fascia having been well divided in the middle line, a broad periosteal elevator or a rugine is introduced, and by means of it the soft parts can be separated from the laryngeal cartilages without employing the knife.

The crico-thyroid, sterno-thyroid, and thyro-hyoid muscles are detached on one side, and are, together with the other soft parts, held with a retractor while the larynx is, by means of a sharp double hook, drawn over to the other side. The attachment of the inferior constrictor muscle to the thyroid cartilage can now be severed, partly by detachment with the elevator or rugine, and partly by cutting it with curved blunt-pointed scissors, which are kept very close to the cartilage. The larynx is now pulled forwards as well as to the opposite side, and the tissues are divided about the gap which intervenes between the cut and now separated ends of the superior thyroid artery. The superior laryngeal nerve is also now divided. The thyroid gland is pushed aside with the soft parts.

If the larynx be now well drawn over to the other side, the other half of the organ can be stripped of its coverings in precisely the same manner.

The next step is to divide the thyro-hyoid ligaments and membrane, and to cut the extra-laryngeal connections of the epiglottis. This structure may be conveniently drawn forwards while its attachments are being freed.

The entire larynx is now pulled forwards by means of sharp hooks introduced into its upper part, and the organ is separated from its remaining connections with the pharynx

and œsophagus—at first laterally, and then from above downwards.

If proper care be taken, the œsophagus should be nowhere “button-holed.” Special care is required to separate the cricoid cartilage from the commencement of the gullet.

The trachea is now secured (unless already adherent) by means of two ligatures, which are held by an assistant, and the excision is completed by dividing the membrane between the cricoid cartilage and the trachea from behind forwards.

One or more rings of the trachea may be removed at the same time if it be considered necessary.

The upper end of the divided trachea, which has been prevented from slipping down by the two ligatures, is now secured to the integument by several points of interrupted suture.

Three or four deep sutures of silver wire are passed beneath the uppermost ring, and are made to attach the windpipe securely to the skin; a further series of fine superficial sutures unite the mucous membrane of the trachea to the cut margin of the skin.

The bleeding throughout the operation will be free, and each small vessel should be ligatured as soon as it is divided. The limited space does not favour the use of many pressure forceps.

Modifications of the Operation.—*The Preliminary Tracheotomy.*—Gussenbauer is opposed to the practice of performing a tracheotomy some time before the excision is carried out. He thinks that it leads to infiltration of the tissues about the trachea, to matting together of the parts around the wound, and thus to unnecessary complications when the trachea is approached in the major operation.

He believes that a high tracheotomy carried out as an initial step in the actual excision is the best practice in the majority of cases.

Excision of the Larynx from below upwards.—This order of proceeding is advised by some. The vertical skin incision having been made, the soft parts are detached from the front and sides of the larynx, and the trachea is exposed. It is divided below the cricoid cartilage, is raised out of the wound,

and is secured to the skin. A cannula is introduced into its lumen, and the tube around is closed by a plug of sponge, to which—as a precaution—a long silk thread is attached.

The larynx is now detached from below upwards.

This method is claimed to be the easier of the two, but it is not recommended by those who are most competent to advise upon the point.

Splitting the Larynx.—In cases where any doubt exists as to the extent of the disease, it is advised that the thyroid cartilage be split open in the median line, and the interior examined, before it is decided that the whole of the larynx must be sacrificed.

The Epiglottis.—Few arguments have been advanced in favour of retaining the epiglottis in cases in which it has been found to be sound. The arguments in favour of removing it are these:—It is of no functional value, it may become the seat of a rapidly-recurring growth, and it interferes with the introduction of an artificial larynx.

The Cricoid Cartilage.—This structure is in most cases removed. When sound, it is advised by some that it be retained, on the ground that it affords an important additional support for an artificial larynx. Hahn, on the other hand, declares that if left, it interferes seriously with the act of swallowing, and that it should in every case be removed with the rest of the larynx.

General Observations.—In clearing the larynx, it is most important that the surgeon should keep throughout as close as possible to the cartilages, and that if a knife be used, he should cut upon the cartilages.

It may sometimes be necessary to divide the isthmus of the thyroid between two ligatures when it is found that there is a difficulty in displacing that body from the larynx.

If any enlarged cervical glands be discovered, they should be removed.

If, after the skin has been reflected, it is found that the carcinoma has extended beyond the larynx, and has invaded the surrounding muscles and connective tissue, the operation should be abandoned.

After-treatment.—The wound is well cleansed with aseptic pads, and is then filled with a light packing of sterilised or iodoform gauze. Before this is applied, the wound may be dusted with iodoform or other antiseptic powder. No sutures are introduced, except in the transverse part of the skin-wound, the edges of which may be brought together by a few points of silkworm gut. A soft indiarubber tube is introduced into the stomach through the wound, and is secured in position by a suture. Through this tube the patient is fed. This mode of feeding must be supplemented by nutrient enemata. The tampon cannula used in the operation is left undisturbed.

The patient must be placed in a warm and well-ventilated room, and, if it be considered desirable, a steam spray may be used to render the inspired air moister.

The gauze dressings should be changed twice or three times in the twenty-four hours, and every care be taken to prevent decomposition from occurring in the wound, and to allow all discharges and secretions to escape.

The tampon-cannula may be removed at the end of twenty-four or forty-eight hours, and replaced by a tracheotomy tube of the largest size. Some surgeons retain the tampon for eight or ten days, as a precaution against the somewhat unlikely accident of secondary hæmorrhage. The tracheotomy tube must be kept scrupulously clean.

As soon as the wound is becoming firm, and the healing has advanced satisfactorily, the œsophageal tube may be removed, and the patient either be encouraged to swallow, or the tube be introduced from time to time as circumstances suggest. The feeding-tube has been left off as early as the fifth day, but it may, on the other hand, have to be worn for some weeks.

It must be borne in mind that it will be easier to swallow solid than liquid food in these cases, and that not a few deaths have been due to pneumonia, consequent upon the decomposition of food which has found its way into the air-passages.

Other elements in the treatment of the case will depend upon ordinary surgical principles.

The Artificial Larynx.—This instrument should not be introduced until the parts are satisfactorily healed, and from

three to five weeks will usually elapse after the operation before any attempts to make use of the artificial larynx will be considered advisable.

The apparatus that appears to be the most satisfactory is Irvine's modification of Gussenbauer's instrument.

It consists of two tubes, a pharyngeal tube (Fig. 337, A) and a tracheal tube (Fig. 337, B). The pharyngeal tube is introduced first, and the tracheal tube is then passed through it. Fenestræ are so cut in these two tubes as to allow of the

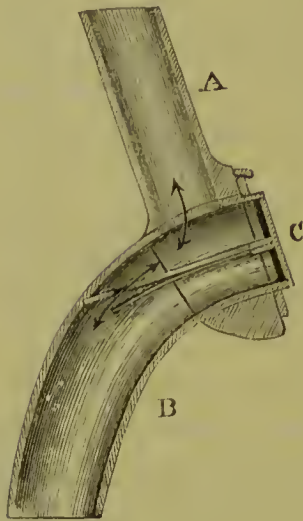


FIG. 337.—IRVINE'S MODIFICATION OF GUSSENBAUER'S ARTIFICIAL LARYNX.

A, Upper tube; B, Lower tube; C, The reed.

free passage of air throughout them (Fig. 337). Lodged in a groove in the pharyngeal tube is a plate carrying a reed (Fig. 337, c). This plate can be pushed in and drawn out after the manner of a table-drawer. It can therefore be readily freed from mucus, and cleaned. The expiratory current produces vibration of the reed, and the tone evolved serves as a basis for articulate speech. The sound is, of course, absolutely monotonous.

Dr. Solis-Cohen comments as follows upon this instrument:—"Great difference is presented in the toleration of these appliances. In some instances they give little trouble, and are used with great comfort. Some subjects bear the naked apparatus well, but cannot tolerate the phonal reed, which may impede respiration, may become obstructed with desiccated mucus, and may yield a tone to every breath of expiration. Some abandon them altogether, and stick to the simple tracheal cannula. In some instances saliva, mucus, and aliment will get into the tubes and descend into the trachea. Some patients prevent the escape of food by plugging the upper orifice with cotton when they eat."

PARTIAL EXCISION.

This operation is carried out upon the same lines as the complete excision. One-half only of the larynx or of the thyroid

cartilage is removed. The details of the operation are practically the same.

A preliminary low tracheotomy may be carried out some little time before the excision is attempted.

The incision is the same, save that the transverse portion need occupy only the diseased side. A tampon-cannula is introduced.

The larynx is laid bare in the middle line, and the thyroid cartilage is divided so that the interior of the larynx may be inspected. Preliminary ligature of the thyroid arteries is unnecessary.

The thyroid cartilage is now removed. It is cautiously bared of the soft parts which cover its outer surface by means of an elevator or a rugine. The surgeon must keep close to the cartilage. The attachments of the pharynx are separated by like means. The thyro-hyoid and crico-thyroid membranes are divided upon the affected side as closely as possible to the margin of the thyroid cartilage. The superior cornu of this cartilage is divided at its base by pliers. The epiglottis is left, and the aryteno-epiglottic fold of the affected side is divided close to the cartilage of Wrisberg. In some cases the epiglottis has been split, and one half removed.

Every care must be taken to avoid opening the pharyngeal cavity. In clearing the cartilage, the elevator and the handle of the scalpel may be now and then assisted by a few snips from blunt-pointed scissors curved on the flat. Bleeding vessels must be taken up and tied as divided.

Mr. Butlin states that in partial excision for intrinsic disease "there is usually not the least necessity to remove the cricoid cartilage." It has, however, in most of the cases been split in the middle line, and one half of the ring has been removed with the half of the thyroid cartilage.

Mr. Butlin is in favour of leaving the thyroid cartilage also, whenever this is possible. He would split the cartilage in the middle line, open the larynx, and then scoop out, as it were, the contents of one-half of the thyroid cartilage. The removal should be free, and when completed the ala should be restored in place. Mr. Butlin points out that cancer of the larynx

far more often causes the death of the cartilage piece by piece than infiltrates it; and even if the surface of the thyroid has been encroached upon, he would be disposed to scrape away the affected part rather than sacrifice the whole ala.

Sir F. Semon (*Monatssch. f. Ohrenh.*, November, 1899), supports this method of operation by a series of fifteen cases treated by thyrotomy. One patient died of the operation, and ten were alive and well at intervals of from one to eight years afterwards.

The after-treatment is the same as in cases of complete excision. The treatment of the wound is the same. The patient will probably be able to take semi-solid food by the mouth in three or four days after the operation, and the cannula may often be dispensed with in the same time.

Results of Excision of the Larynx.—The usual causes of death are shock and hæmorrhage, and, above all, pneumonia. The risk of death from pneumonia must be present for at least fourteen days after the operation. The failure of antiseptic precautions, the passage of food and discharges into the bronchi, and the development of bronchitis from the altered mode of breathing, are the usual factors in the production of this complication. In complete excision the mortality directly due to the operation itself is over thirty per cent. In partial excision it is less.

The relief afforded in complete excision has been, in the majority of cases, of but short duration, early recurrence being the rule. The state of some of the patients after the operation has been very miserable. If it be true that a palliative tracheotomy in cancer of the larynx may allow life to be prolonged some two and a half years, there must be strong evidence adduced to justify the complete removal of the organ.

The immediate success which has attended partial excision of the larynx in suitable cases has been more gratifying. The mortality has been lower, and the patient has been able to swallow with ease, and to speak with sufficient clearness to enable him to make himself quite understood. With regard to complete excision, Mr. Butlin wrote in 1887:—"Complete excision of the larynx has hitherto been in every respect un-

successful. . . . And were it not that better results may be hoped for in future—by better management of the patients, and by much greater care in the selection of cases—the operation must be condemned as unsurgical” (“The Operative Surgery of Malignant Disease,” 1887).

A later review of this question is given by Mr. Butlin in the *British Medical Journal* for August 23rd, 1890.

The following table is abstracted from that paper:—

	OPERATIONS FOR MALIGNANT DISEASE.	DEATHS DUE TO THE OPERATION.
Thyrotomy	28 cases	3 deaths
Partial excision of larynx	23 „	7 „
Complete excision of larynx	51 „	16 „
	<hr/> 102 „ <hr/>	<hr/> 26 „ <hr/>
Out of the 28 cases of thyrotomy	3 are pronounced cured	
„ 23 „ partial excision	4 „ „ „	
„ 51 „ complete excision	8 „ „ „	
	<hr/> 102 cases <hr/>	<hr/> 15 cases of cure. <hr/>

[By “cure” it is meant that the patients were alive and free from disease at periods of from three to twenty years after the operation.]

Sendziak (*Monatssch f. Ohrenh.*, Berlin, September, 1899) has tabulated the results in 640 cases of operation for cancer of the larynx. This paper shows that the mortality was much lower after thyrotomy (6·6 per cent.) than after complete excision (14·2 per cent.). The cures after complete excision were estimated at 1·5 per cent., after thyrotomy, at 11 per cent. The prognosis evidently depends upon getting the case early enough, when the cancer is intrinsic and can be treated by thyrotomy with success.

Other recent collections of cases lead me to place the direct mortality of both partial and complete excision of the larynx considerably higher than Sendziak states. It must be remembered that only successful cases tend to get into the literature. After complete excision the mortality is probably at least 30 to 40 per cent.; after partial excision, 25 per cent.

CHAPTER III.

EXCISION OF THE THYROID BODY.

Anatomical Points.—The normal relations of the thyroid gland or body must be clearly appreciated before any operation is attempted upon this very dangerously-placed structure.

Most important is it to note the relations of the gland to the trachea and gullet, to the recurrent laryngeal nerve, and to the sheath of the great vessels of the neck.

The thyroid gland has a very large blood supply. The superior thyroid arteries—from the carotids—descend to reach the apex or upper part of each lobe. They supply the front and inner parts of the body. The inferior thyroid arteries are larger than the superior, enter the lower extremity of each lobe, and supply the posterior, inferior, and outer parts of the body. Each vessel runs for some little distance on the posterior surface of the thyroid before it pierces it. The thyroidea ima may supplement deficiencies in the other arteries, and when present will enter the lower part of the gland near the median line.

The superior thyroid veins follow the arteries, and end in the internal jugular. The middle thyroid veins pass out transversely, and enter the internal jugular a little below the level of the cricoid cartilage. The inferior thyroid veins descend as an irregular plexus on the trachea, and end in the innominate veins.

The quantity of blood contained in the softer varieties of goitre is enormous, and the size and number of the veins which leave it are remarkable. Partial or complete excision of the thyroid gland is usually carried out in certain selected cases of non-malignant bronchocle, especially in such as are causing severe disturbance from pressure. In the treatment of

malignant disease of the thyroid the experience of surgeons up to the present time has been so unsatisfactory as to render it a question whether the operation is justifiable.

It will be evident that in cases of bronchocele the relations of parts may be much modified, essential landmarks may be lost, and vessels and other structures displaced.

The bronchocele may extend to great depths, may surround the trachea, and may have so insinuated itself among the various structures of the neck as to render any attempt at excision either desperate or entirely unjustifiable. One important form of goitre is the substernal one, in which an abnormally low portion of the gland enlarges and may produce rapid obstruction of the trachea behind the sternum. Operation should always be resorted to as early as possible in these cases.

Dangers of the Operation.—In some instances, when the bronchocele is small and well encapsuled, its enucleation, or the excision of one-half of the gland, may be carried out without much difficulty. But these simple cases probably do not form more than half the number that require operation.

In many instances these excision operations are dangerous, tedious, and difficult, and demand the exercise of the highest qualities of a good surgeon. The larger the mass, the less defined its capsule, the broader its base, and the more vascular its structure, the less easy is the operation. The following are the principal dangers:—

1. *Hæmorrhage.*—In the course of the excision there is no great difficulty in dealing with the arteries. It is the veins which are the source of the trouble. They are found to be numerous, to be very large, to be arranged according to no familiar anatomical lines, and to be usually thin-walled. The dyspnoea from which the patient suffers causes them to be abnormally distended, and to bleed furiously if they be accidentally divided.

In the softer and more vascular forms of bronchocele the splitting of the comparatively thin capsule exposes a soft pulpy tissue, from which blood pours as if it were being wrung out of a sponge: No form of bleeding is less easy to deal with than this.

In indistinctly-encapsuled and wide-spreading goitres the carotid artery and the jugular vein are in danger, and the artery may be wounded or the vein torn.

2. *Injury to the Recurrent Laryngeal Nerve.*—This nerve is in intimate relation with the inferior thyroid artery, and in securing that vessel—or, rather, the series of vessels which represent it—it is by no means difficult to damage this important nerve. The accident has happened many times. The nerve has been in some instances cut, in others it has been included in a ligature, and in a third series of instances it has been torn or severely stretched.

3. *Cellulitis.*—So extensive a tract of the connective tissue of the neck is opened up that if the wound become septic, there is little to prevent a diffused form of suppurative cellulitis, which will almost inevitably lead to death.

Hence, a preliminary tracheotomy adds decidedly to the risk of the major operation, owing to the chance of septic infection of the wound. When severe dyspnoea is produced by the pressure of a goitre on the trachea, it should be treated, if possible, by excision of the tumour and not by tracheotomy.

Complete Excision.—This term is used in an elastic manner—for complete excision in the sense of removing the whole of both lobes and the isthmus should never be performed, because of the great risk of the gradual development of a “cachexia strumipriva.” This condition resembles myxœdema, and is inevitably fatal in its ending. Hence, some portion of the thyroid gland should always be left behind; it will hypertrophy, and prevent this unfortunate result of the excision. The method of operating here described is that known as Kocher’s. The patient lies upon the right-hand side of the table, with the shoulders well raised and the head extended over a large sand-bag or hard cushion. The chin should be kept in a line with the sternal notch, and the head be well fixed. The anaesthetist stands at the head of the table, and the chief assistant to the surgeon’s right. Every preparation must be made for extensive hæmorrhage. The anaesthetic should be chloroform, or at least the

A.C.E. mixture, should chloroform be distinctly contra-indicated. Ether increases to its utmost the engorgement of the veins of the head and neck.

If a general anæsthetic be used, the patient should be kept only just under its influence. Owing to the special danger in goitre operations of sudden dyspnœa, Professor Kocher strongly recommends eucaine or cocaine and morphia injections instead of a general anæsthetic. A preliminary injection of morphia ($\frac{1}{6}$ to $\frac{1}{4}$ of a grain) and the local injections of eucaine (1 to 2 per cent. solution) will enable the surgeon to carry out a formidable operation, the most painful step being the final insertion of the sutures.

An incision is made in the median line from the sternal notch to the upper limit of the bronchocele. From this point two lateral incisions are made upwards and outwards, one on each side. They are directed towards a point a little below the angle of the jaw, and when the cutaneous cut is complete it will have the outline of the letter Y. If the tumour be much more extensively developed on one side than on the other, the upper or oblique incision may be limited to the affected side. In any case the incision must not be spared. A primary requirement is that the tumour be very freely exposed. The lateral or oblique cuts will usually pass over the anterior borders of the sterno-mastoid muscles.

The platysma and fascia are divided. Any veins which are met with are secured between two ligatures of catgut, and divided. The sterno-hyoid and sterno-thyroid muscles will be found to be stretched over the goitre. These structures will probably be much thinned and very altered in appearance.

The surgeon must make his way down to the gland, and must convince himself that he has opened up the plane of connective tissue beneath these muscles, and is not wandering aimlessly over the outer surface.

The sterno-hyoid, sterno-thyroid, and omo-hyoid muscles will need to be divided in whole or in part. They should, however, be respected as far as possible, and drawn to the outer side of the tumour.

It may be necessary even to cut one or both of the sterno-

mastoid muscles. The operator must trust but little to retractors, but must rather aim at obtaining the fullest view of the bronchocele by dissection.

The muscles named will very often be closely adherent to the tumour, and in clearing them away the scalpel must be used very sparingly.

No instrument is more serviceable in this stage of the operation than a broad periosteal elevator. Its point is so blunt that it can do little damage, and its configuration is admirably suited to peel the tissues away from the capsule. This must be done with great care. The elevator is made to work its way beneath the muscles and the fascia, and when the precise relations are clear the tissues are divided over the elevator as over a director. In effecting this exposure of the goitre a pair of blunt-pointed scissors curved on the flat is more useful than a scalpel, and the handle of the scalpel is of more service than the blade. The elevator must not be vigorously thrust here and there, but must be made to find an easy path. No tissue should be cut until it has been well examined, and any especially resisting structure must be exposed before it is torn across or cut.

A plexus of large, thin-walled veins will usually be found covering the tumour. They must be separately treated, and must be individually divided between two ligatures. These vessels are easily torn across, and are very apt to be adherent.

If the head be in the position of extension, the structures on the front of the neck, and especially those over the face of the tumour, are apt to be stretched, and a vein so stretched may be quite unrecognisable. It is well, therefore, to have the head lifted now and then, so that the veins to be dealt with may be brought well into view.

Step by step the surgeon clears the whole of the front surface of the swelling, dealing with every bleeding point as it is met with, and not trusting either to the pressure of fingers or of sponges, or to artery forceps.

When the anterior surface is cleared, the next step is to approach the lateral margins of the growth, and to secure the thyroid vessels. It must be remembered that the thyroid body touches the carotid sheath. The position of that vessel

should be made out as early as possible, and the utmost care taken to avoid it. If the bronchocele is in close contact with the main vessels, some special care may be required in separating the huge internal jugular vein from the capsule. The superior thyroid artery is then sought for at the upper extremity of the tumour. It may not be made out without some difficulty. If the vessels cannot be individually isolated, a double ligature may be passed by means of an aneurysm needle, and the vascular pedicle ligatured in two places and divided between. The vessels embraced by these ligatures may be separately sutured at a later period if thought necessary. The inferior thyroid artery is less easy to deal with. It is more deeply placed, has more numerous veins in relation with it, and is closely connected with the recurrent laryngeal nerve. No pains should be spared to expose it well. Baumgartner recommends that the ligatures be applied at some distance from the lower border of the tumour, and that the branches of the artery be cut through just as they enter the bronchocele. In this way there is less danger of including the recurrent nerves.

The whole of the lateral border of the tumour is now separated. The same precautions are observed. The blunt elevator is the chief instrument. The scissors are used as required, and the vessels encountered are all ligatured and divided in the manner described.

The mass is turned over towards the opposite side, and the posterior surface of the tumour cleared as far as the posterior median line.

The other lateral lobe is dealt with in precisely the same manner, and in due course the whole tumour is removed, with care to leave some portion of the gland behind.

The wound is now examined, and any remaining bleeding vessels are secured. No irritating antiseptic solutions should be used to the wound. The less it is rubbed with a sponge the better. The margins of the skin incisions are united with silk-worm-gut sutures, which are not too closely applied. A drainage-tube is rarely necessary, though a fine spiral one will do no harm.

The best dressing consists of a large pad of sterilised gauze and wool, the former being dry when applied. It is bandaged

in position, with as much pressure as it is considered safe to apply, by means of a light muslin bandage.

When the patient is placed in bed, the shoulders and head must be kept well raised, and the head may be fixed in the hollow of a loosely-filled sand-bag.

Partial Excision.—Excision of one-half of the thyroid with division of the isthmus, is conducted in precisely the same manner as the above operation.

The incision is usually oblique, made along the anterior border of the sterno-mastoid muscle. The front of the bronchocele is cleared, and the superior thyroid artery secured.

After this vessel has been dealt with, the isthmus is severed. The fascia around it is divided, and the isthmus is then separated from the trachea by an elevator or director, and is well isolated. It may be then transfixed by a needle in a handle—such as is used in ovariectomy—and secured by a double set of ligatures, which are placed upon each side of the spot at which it is intended to divide it. It is treated somewhat like the ovarian pedicle. In cases of very large isthmus more ligatures may be called for. In some instances the isthmus may be more conveniently divided with a scalpel, and ligatures applied as required.

The tumour is now almost completely isolated, and the last step consists in ligaturing the inferior thyroid artery.

Enucleation.—When a goitre consists of a localised cyst or adenoma, it may be enucleated by peeling off the surrounding gland by means of an elevator. Care must be taken that the incision goes down into the actual wall of the tumour, and the size of the latter may often be diminished by tapping before it is shelled out. A formal ligature of the main thyroid vessels is not required, but all vessels going into the tumour should be secured with pressure forceps before division.

Mr. Berry recommends in these cases a transverse incision placed low down in the neck, as the resulting scar will be less conspicuous than a vertical or oblique one. The transverse incision, however, does not give so much room as the others.

Tracheotomy in these Operations.—If there be much dyspnoea in these cases of excision of the thyroid, the mass should be relieved from its tense surroundings as soon as possible, and the pressure removed from the trachea. Some assistance in this direction may be afforded by altering the position of the head, and by having the mass, as far as possible, withdrawn from the windpipe.

More immediate relief may be obtained probably by dividing the isthmus.

Tracheotomy is most emphatically to be avoided. The operation, if performed, would be carried out under the greatest difficulties, and the gravity of the whole procedure much increased.

Tracheotomy in these cases nearly always leads to a fatal issue. It is impossible to prevent the huge wound from becoming septic, and the patient soon dies of septic pneumonia or suppurative cellulitis. An excision of the thyroid, accompanied by tracheotomy, is so desperate an operation that it must be regarded as quite unjustifiable as a deliberately planned procedure. In most of the cases the tracheotomy was called for unexpectedly after the excision had been commenced; but to complete an excision after a tracheotomy has been performed is a forlorn hope indeed.

After-treatment.—This calls for no especial notice. If a drainage-tube has been used, it should be removed in twenty-four or thirty-six hours.

The shoulders should be kept raised, and the head well fixed, by being buried in a sand-bag.

In applying the dressings the bandages must be passed under the axilla, across the front of the chest, across the scapular region, and over the head, in order to secure a firm and tight covering for the wound.

Food is given by the mouth.

The treatment is, indeed, that merely of a deep and extensive wound in the neck.

At a later period healing, if delayed, may be promoted by fixing the head in a jury-mast, or by applying the cap used in the treatment of cases of cut throat.

Results.—These operations, besides involving the ordinary

surgical issues, involve also, in the cases of complete excision, the possibility of cachexia strumipriva. The matter has been carefully investigated by the committee of the Clinical Society on Myxœdema (*Clin. Soc. Trans.*, Supplement to vol. xxi., 1888, pages 162, 197).

The results are given as follows:—

“In a total of about 408 intentionally complete thyroidectomies, performed by fifty-six different surgeons, there were fifty-nine deaths in consequence of, or shortly after, the operation.

“In twenty cases the operation was performed for malignant disease of the thyroid gland.

“Deducting the cases of death from, or shortly after, the operation, the cases in which there was malignant disease of the thyroid gland, and the cases which were lost from observation almost immediately after the operation, there remain 298 cases in which total thyroidectomy was performed for simple goitre, and in which the patients are known to have fully recovered. Of these, in 277 instances the further fate of the patients could be followed up, with the result that in twenty-two cases either recurrence of goitre, or development of accessory thyroid glands, appears to have taken place; that in 186 cases the patients appear to have remained free from cachexia strumipriva, without recurrence or development of accessory thyroids having taken place; and that in sixty-nine, cachexia strumipriva of a more or less severe type developed.”

Of late years partial excision of the thyroid gland has been carried out in many cases of *exophthalmic goitre*. The direct mortality has been considerable, and the benefit is so uncertain that the operation is probably not justifiable.

With regard to the ordinary cases of cystic or parenchymatous goitre, the experience of some Continental surgeons has been very large; for instance, Professor Kocher of Berne has performed 2,000 such operations, with a mortality of 6 per cent. He is a strong advocate of aseptic, in distinction from antiseptic, methods, and of local, in preference to general, anæsthesia.

Mr. James Berry, in a valuable paper (*Brit. Med. Journal*, July 7th, 1900), reports seventy-two cases with only three deaths. In thirty-nine of these he was able to enucleate the tumour, with no fatal case.

CHAPTER IV.

REMOVAL OF TUMOURS OF THE NECK.

THE somewhat wide and varied series of operations which could be included under the above title may be very conveniently represented by the operation for the removal of tuberculous glands in the neck. The previous chapter, on Removal of the Thyroid Body, affords an example of a special operation for the excision of a large cervical tumour.

REMOVAL OF TUBERCULOUS GLANDS.

These tumours exhibit such infinite variety as regards number, position, relations, and physical characteristics, that their removal will involve a series of surgical procedures which extend from an operation of the very simplest character to one which is both complex and difficult. With Mr. Treves, of Margate, must rest the credit of first systematically treating all tuberculous glands of a certain grade by excision.

The trouble to be dealt with may be limited to a single gland, which is well-defined, well-encapsuled, firm, superficial, and more or less free from adhesions to surrounding parts.

Such a tumour, when exposed, "shells out" with the greatest ease, and the operation involved is of the most rudimentary description.

More usually, however, the surgical position lies within less simple lines. The glands are numerous, and are matted together. The more superficial tumours are connected with a string of others which are more deeply placed, and which may extend even to the anterior surface of the spine. These glands

are of varying consistence ; while some are firm, others are soft, and possessed of so thin a capsule that little force is required to tear them open and allow their creamy and caseous contents to escape.

Not only are they matted together, but they are wedged in among the tissues of the neck, and are fixed by adhesions which, for extent, for toughness, and for their capacity to obliterate the anatomical details of the part, have few equals in other regions of the body. The surgeon who commences to remove a large collection of tuberculous masses in the neck is setting forth upon no light undertaking, and must at first remain uncertain as to the direction in which he will be led, and as to the limit which he may reach.

The number of the tumours is often considerable, and no sooner is one string or cluster removed, than another comes into view.

Dangers of the Operation.—The chief dangers in the operation consist in (1) the possible wounding or tearing of nerves and other structures, (2) hæmorrhage, and (3) the entrance of air into wounded veins.

An operation of this kind should never be undertaken unless the surgeon has perfect confidence in his practical knowledge of the anatomy of the neck.

Scarcely an instance can be cited in the range of operative surgery where a knowledge of structure and of relations is more essential than in these excisions.

1. *Possible Wounding of Nerves and other Structures.*—The nerves, as a rule, give comparatively little trouble. They stand out well upon the matted tissues, and their isolation is seldom a matter of difficulty.

A nerve may be actually lost in a malignant growth of the neck, but a nerve passing through a coherent mass of tuberculous glands can nearly always be recognised, followed, and isolated. The nerves which usually come in the way of the operation are the ascending and descending branches of the cervical plexus, the superficial cervical being the one most commonly exposed. These nerves may be divided when such division appears inevitable, and no ill will follow. Indeed, in

some instances of pain in the course of these nerves, produced by the pressure of the tumour, the section of one or more of them may now and then be deliberately carried out. The rule, of course, should be to isolate them, and to draw them aside with retractors, of which blunt hooks are the most convenient form.

Of larger and more important nerves the one which most frequently comes across the operator's path is the spinal accessory in the posterior triangle. An accidental division of that nerve is very readily effected. One author states that, in removing glands from the neck, he has divided this nerve more than fifty times (*St. Thomas's Hospital Reports*, vol. xviii., page 218): He adds that, "although most careful search was made for symptoms due to its division, none could ever be found." From this observation it must be gathered that the nerve divided was the supra-acromial or the outer supra-clavicular, and not the spinal accessory. These cutaneous nerves are large, and can readily be mistaken for the motor trunk. If the latter nerve—when exposed—be scratched with the point of the knife, a twitching in the trapezius will always be noticed, no matter how deeply the patient is anæsthetised; and division of the spinal accessory nerve will certainly lead to partial paralysis of the muscle.

The next nerves of primary importance are the phrenic, the vagus, and the recurrent laryngeal. It is very rare indeed for these nerve-cords to enter the field of the operation during the excision of tuberculous glands. Their division or injury in these

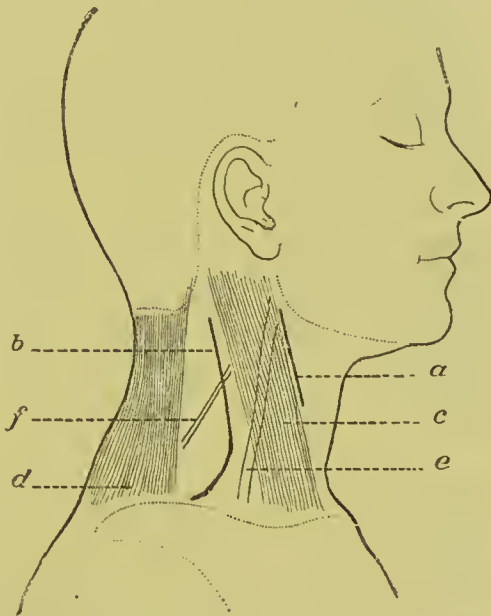


Fig. 338.—INCISIONS FOR REMOVAL OF TUBERCULOUS GLANDS.

a and *b*, lines of incision for removal of glands in anterior and posterior triangles of neck; *c*, sterno-mastoid; *d*, trapezius; *e*, external jugular vein; *f*, spinal accessory nerve. These incisions may require to be much modified in certain cases.

operations is inexcusable. More than one case has, however, been recorded.

The pneumogastric has been divided without a fatal result. The descendens noni is not unfrequently severed. The cervical sympathetic has been wounded in removing a deep-seated tumour which pressed upon the pharynx (*Clin. Soc. Trans.*, vol. xix., page 321). Sarcomata and other tumours have been dissected off the phrenic, the vagus, and the cords of the brachial plexus.

In every case the surgeon must make a most careful examination before operating, with the purpose of ascertaining if any symptoms are present which indicate pressure upon the nerves in the neck; and if such symptoms exist, he must take special care to isolate the nerve or nerves thus individualised.

In removing enlarged glands or other growths—such as lympho-sarcomata—from the root of the neck, two structures must be particularly respected—one is the dome of the pleura, which ascends some distance into the neck, and the other is the thoracic duct. The pleura is readily torn in dealing with a deeply-seated and adherent mass.

One surgeon, from whose work a quotation has already been made (*St. Thomas's Hosp. Reports*, vol. xviii., page 219), states that he removed the extreme tip of the lung in the course of one operation for tuberculous glands. He states, very properly, that it was a "most remarkable case."

Several cases of wound of the left thoracic duct have been recorded during the removal of glandular or other tumours from the posterior triangle. It is a most serious accident, although not always fatal. It is asserted that after such division the two ends have been successfully sutured together, but to believe this requires much faith. The risk to the thoracic duct in excision of scirrhus glands deeply placed above the clavicle is one amongst several reasons against this operation.

In dealing with gland cases, it is quite possible that the submaxillary salivary gland may be mistaken for a lymphatic tumour, and that its true character may not be discovered until the mass has been cleared for removal.

The parotid salivary gland could scarcely be the subject of such a mistake.

2. *Hæmorrhage*.—The bleeding in these cases may be very free, but it will be nearly always venous.

There is no difficulty in dealing with the arteries; their position is known, and when they are cut a sharp spurt of blood directs the surgeon at once to the bleeding point. The vessel is readily picked up. A word of warning is required with regard to the carotid bifurcation. This may be situated on a level with the hyoid bone, and, owing to dilatation of the vessel, in some cases may simulate a gland. As is well known, some lymphatic glands are always situated close to the bifurcation.

It is the venous bleeding that is troublesome. The wound is deep, and its depths are not easily illuminated; the blood wells up in a steady and often copious stream, and the details of the operation area are lost.

If the glands are fixed in any given case, it may be taken for granted that they have acquired an extensive hold on the veins of the part, if of no other structures. The lymphatic vessels run mainly with the veins, and this intimate association of the lymphatic tumours and the blood-channels is readily explained.

The veins so involved are found to be enlarged, and tortuous and devious. Sometimes they are stretched over the gland, and are more to be compared to bands of tape than to tubes.

Very often they have been so drawn upon and so extended that they cease to look like veins, and are cut across under the impression that the knife is dealing with a band of connective tissue.

In many cases it is impossible to isolate the vein from the lymphatic tumour, and the vein, if small, has to be sacrificed. In more than one instance I have had to determine whether I should leave a portion of the tumour behind, or remove an inch or so of the internal jugular vein, in cases in which the growth had attached itself to that great trunk. In dealing with tuberculous glands, it is better to spare the vein, to excise as much of the mass as can be removed, and then to pare down what remains with a Volkmann's spoon, until nothing but a fragment of capsule is left clinging to the vein. In dealing with malignant tumours the vein may have to be sacrificed. I have

accidentally wounded this vein on two occasions in removing tuberculous glands, and have then isolated the wounded part between two ligatures. I have seen no harm arise from this undesirable complication. Sometimes an accidental puncture of the vein has been successfully closed by a fine silk ligature applied without occluding its lumen. Some surgeons in operating on a chain of tuberculous glands more or less adherent to the internal jugular do not hesitate to ligature it high up, and strip it off the companion artery for some distance, removing it with the glands. A second ligature is, of course, applied below. This introduces a complication which in most cases may cause no trouble, but it is certainly not free from risk, and in nineteen cases out of twenty can be avoided with patience and care in operating.

In other cases, as in removing cancerous glands from the neck, I have excised an inch or so of the internal jugular vein, and have in these cases also seen no evil follow from the practice. I might here add that if a malignant growth has acquired such a hold upon the part as to have completely buried the internal jugular vein in its substance, the circumstances must be very pronounced which would justify a persistent and determined attempt at excision. Early recurrence would be inevitable.

In some cases of extensive tuberculous disease I have found certain of the minor veins, such as the superior thyroid, lingual, or facial, of such enormous size as to be for the moment mistaken for the jugular.

In dealing with the lower part of the posterior triangle, the external jugular vein may require to be divided between two ligatures.

3. *Air in Veins*.—In these operations there is some danger of the entrance of air into the divided veins.

I have recorded certain examples of this terrible accident (*British Medical Journal*, June 30, 1883), and have dealt with the subject at some length in Heath's "Dictionary of Surgery," vol. i., page 27.

It is only necessary here to point out that the accident can only occur in what may be termed dry wounds—wounds cleared of all blood by sponging, etc. The injured vein must either be

exposed to the air, or be separated from the air by only a thin layer of blood, before it is possible for air to be drawn into the vein during the act of inspiration. If the wound be full of blood, the accident is impossible. It occurs most usually when a tumour is being dragged from its attachments, or just after a deep incision has been sponged out.

The treatment of the complication is as follows:—The moment the hissing sound is heard, the wound should be filled with sterilised water squeezed from a sponge. This at once prevents the entrance of more air. It is useless at the first to attempt to tie the vein. The damaged vessel is not easy to find, and to apply a ligature involves time. Moreover, if the ligature be applied during an inspiration, it would certainly prevent the entrance of more air; but if applied during an expiration, it would merely prevent the escape of such air as had already entered.

The second step is to endeavour to remove the air that has already entered the chest. This can be best effected by waiting until the next expiratory movement, and then bringing forcible pressure to bear upon the front of the thorax.

The ease with which a large quantity of air can be thus expressed is remarkable, especially in children.

When all air has been expressed, the vein should be seized with pressure forceps and ligatured. The suggestion that air should be sucked out of the right auricle through a catheter passed into the heart through one of the main veins is preposterous. The advice given in nearly every text-book, that artificial respiration should be resorted to, is almost as silly. There is not too little air in the thorax, but too much.

The Operation.—The patient lies upon the back, with the shoulders very well raised, and with the face turned towards the sound side. The forearm of the affected side is placed behind the back. The patient's hair and scalp are completely enclosed in an indiarubber cap, or if this is not available, by a sterilised towel tightly secured. Some moist sterilised packing is wedged in under the nape of the neck, to absorb any blood which may run down in that direction. It is important that the general pose of the part should be such that blood can

escape rapidly from the wound and not obscure the movements of the operator. A good light, and at least one good assistant, are necessary.

If the administration of ether leads to marked venous congestion, it may be changed for chloroform or the A. C. E. mixture. The incision must depend upon the site and size of the masses, and must be subject to infinite variation.

In dealing with glands in the upper part of the anterior triangle, the best position for the incision is along the almost transverse skin crease which crosses the neck about the level of the hyoid bone. A fine cicatrix, following this natural fold, may in time become almost invisible. In the lower part of the posterior triangle a transverse incision is also to be advised. Elsewhere the incision may be oblique, and should follow the general line of the sterno-mastoid muscle (see Fig 338).

On the ground of the after-appearance, an absolutely vertical incision at right angles to the clavicle cannot be advised. Through a superior transverse incision, and an inferior oblique one, nearly every gland in the anterior triangle can be reached, and in most instances these two incisions are better than a single vertical one of considerable length.

The skin incision must be free, and the success of the operation should never be compromised by attempts to reduce the scar to the minutest possible limits.

The skin, and platysma, and deep fascia are divided.

The sterno-mastoid, when exposed, must be well freed and held aside by retractors. It may be necessary in rare instances to divide part or the whole of the muscle. This should, however, be always regarded as a most exceptional proceeding. A free division of the muscle may lead to a pronounced form of wry-neck. Glands buried beneath the muscle can be exposed by retractors, or reached through incisions placed on either side of the muscle.

The deep fascia must be divided along the full length of the wound.

When the mass of glands is reached, they may be found to be non-adherent, and to be capable of being "shelled out" with perfect ease.

As a rule, however, these glands are adherent, and the surgeon's first care must be to find out the least adherent side of the tumours or tumour.

He must take care that his dissection has extended down to the very capsule of the gland, and the rule repeatedly insisted upon by Mr. W. Knight Treves, in his many papers upon this subject (*Lancet*, 1888 and 1889), that throughout the whole operation the surgeon must keep close to the capsule, cannot be too accurately observed.

As soon as a little clearing has been effected, the surgeon introduces his finger and seeks for the least fixed part or parts of the tumour. It is from these less adherent sides that the growth is attacked.

It is well that it should be approached from more sides than one. In digging out, as it were, the fixed gland, the scalpel is considerably assisted by blunt-pointed scissors curved on the flat.

A most useful instrument, however, in this part of the operation, is a simple old-fashioned periosteal elevator of small size.

By means of this instrument the tissues over the gland may be peeled off, adhesions may be separated, and the gland be lifted out of its bed. Another useful instrument at this



Fig. 339.—COOPER'S HERNIA DIRECTOR.

stage is Cooper's hernia director (Fig. 339), which is round-pointed and more slender than the elevator, but which is, however, used rather as an elevator than as a director.

The clearing of the gland must be carried out gradually, and the process is tedious enough.

It is unwise to attempt to tear the mass out. If such be done, the gland will either break up and its softened contents escape, or a nerve to which it is adherent may be ruptured, or a part of the wall of a large vein be torn right away. Before a strand or bridge of tissue is divided, it should be relaxed a little, so that its true nature may be perceived. A vein put much upon the stretch may look like a band of connective

tissue. If a layer of tissue, to be divided, be drawn up from the depths of the wound, it is well not to cut it at once while it is on the stretch, but first to relax it a little, so that its character may be better appreciated. In this stage of the excision the main axioms should be—keep close to the capsule; make no cut in the dark; be chary of cutting tissues which are only seen when put fully upon the stretch.

In process of time a kind of pedicle will be formed to the once adherent glands, and when this has been reduced to its smallest limits it should be held by two fenestrated artery forceps, and divided close to the glands. It may or may not contain vessels which require a ligature. In any case the forceps will prevent the stump from dropping out of view, and in general terms it may be said that the inclusion of a large pedicle of uncertain composition within one ligature is to be condemned.

Every care must be taken to avoid wounding veins unnecessarily. Many have to be cut, and should in all cases be at once secured with a ligature, or with pressure forceps. With properly sterilised thin catgut there can be no fear of the sutures giving trouble, and it is best to apply one to every severed vessel of any size. It is, however, surprising how quickly and easily the bleeding is checked so soon as the glands are removed and the traction released.

The greatest difficulty occurs when a large adherent vein has been opened by tearing. In such a case an inch or more of one side of the vein may have been removed. Pressure forceps avail little. The vein must be isolated, and secured above and below the rent.

Care must be taken not to tear or wound the gland capsule. If this has been done the purulent or caseous contents escape, or the soft gland substance is squeezed out. The firm tumour becomes a flabby bag, the depths of the wound are obscured, and the removal of the collapsed gland is difficult. In such a case the capsule must be carefully dissected and scraped away, piece by piece, after the gland has been evacuated, and the wound well cleared out.

Now and then it may be found to be impossible, or at least very unwise, to complete the excision of a deep-seated gland.

The surgeon must have good grounds for coming to this conclusion. The glands which have to be abandoned are exceedingly few, and neither lack of knowledge nor lack of perseverance should form bases for this determination. The gland so placed must be evacuated and cleaned well out with the sharp spoon. The capsule must then be dissected away as completely as is possible, and what tissue remains must be reduced to the smallest possible proportions by a further diligent application of the sharp spoon. I have found this measure to answer well, to place no obstacle in the way of primary union, and usually to lead to no further trouble.

The removal of the gland, however, with its capsule entire, is the only completely satisfactory measure.

The deep wound left by the operation must be well flushed out with some weak antiseptic solution, and every trace of bleeding must be checked.

Pressure with a sponge is the most effectual measure for minor hæmorrhages.

The wound may now be closed. Small blunt hooks are introduced in the manner already described (page 46, vol. i.) in order to ensure accurate approximation of the edges.

Silkworm gut is by far the best suture material. The threads are all introduced, and before the first one is tied the surgeon must satisfy himself that the wound is still clear of clots. The highest sutures are secured first, and as they are tied the assistant follows the closing wound with a sponge, which should be so firmly pressed upon the part as to obliterate the wound cavity. In all cases in which the operation has been extensive, and the wound deep, or in which there has been much bleeding, or portions of tissue have been left behind, it is well to introduce a drainage-tube. This tube must be removed at the end of twenty-four hours. I have tried to dispense with drainage-tubes, but with less satisfactory results.

The best dressing for these cases is a large sponge or a dry pad of sterilised gauze, packed round with cotton-wool. The pressure applied while the sutures are being secured must never be relaxed, and the dressing must be made to press firmly upon the part. The bandage, to obtain a good hold of the neck,

must usually be carried beneath the axillæ, and possibly over the head.

The pressure brought to bear upon the wound may cause some blueness of the face until the effects of the anæsthetic have passed off. I think also that this interference with the venous current from the head may possibly delay the recovery from chloroform.

If the patient have very enlarged tonsils, the operation should not be attempted until the tonsils have been removed, because a properly firm dressing can seldom be applied in such a case without producing symptoms of suffocation.

The **After-treatment** of these cases calls for little comment. The firm dressing, the collar of cotton-wool, and the elaborate bandaging, keep the neck stiff. In children the part may be maintained more completely at rest by fixing the head in a loosely filled sand-bag, as Mr. William Knight Treves advises. Rest of the part is most essential, and should be observed with the utmost rigour for seven to ten days—that is to say, if primary healing with the minimum amount of scarring is desired. The child should not be encouraged to talk, and all its food should be soft or fluid, so that the muscles of mastication may be used as little as possible. The drain should be removed at the end of twenty-four hours, and the sutures between the sixth and the eighth day. A small dressing of gauze and collodion or celloidin solution is very convenient after the first few days, as in the case of most wounds about the head and neck. The celloidin solution is made as follows: Celloidin, 5 parts; ether and ethyl alcohol, of each 15 parts. It dries more rapidly, and forms a better pellicle than collodion, but contracts more firmly, and may thus pucker the skin.

CHAPTER V.

EXCISION OF THE TONGUE.

Excision of the whole or of part of the tongue is carried out for the relief of many conditions. The great majority of the operations, however, are performed for malignant disease.

Cancer of the tongue is most usually situated on the dorsal aspect, and is especially common at the margin of the organ. It is comparatively rare on the under surface or at the tip.

An excellent epitome of the history of the operation has been furnished by Woelfler, and elaborated by Mr. Barker ("Holmes's System of Surgery," third edition, vol. ii., page 597. 1883). From this it appears that Pimpernelle, who died in 1658, was probably the first to excise the tongue with success. Guthrie (in 1756) is stated to have been the first English surgeon to excise a cancer of the tongue, using the knife and cautery.

The Various Methods of Operating.—The following facts are derived from Woelfler and Barker's epitome:—

The Ligature.—The removal of the tongue by strangulation with a ligature was carried out by Inglis (1803) and others. The organ was usually split, and a ligature applied to each half. Cloquet (1827) introduced the ligature through a suprahypoid incision.

The Écraseur.—This instrument was introduced by Chassaignac in 1854, and has been extensively employed. It has been used through the mouth, or introduced through a suprahypoid incision after Cloquet's method. Both the cold wire and the galvanic écraseur have been made use of.

Preliminary Ligature of the Lingual Artery was introduced by Mirault in 1833. The method has been employed by Roux and Roser, and has been within more recent times revived by Billroth.

Division of the Cheek.—This was carried out by Jaeger in 1831, in order to obtain free access to the tongue. Maisonneuve (1858) and Collis (1867) advocated and employed this method.

Division of the Lower Jaw has been effected to obtain a ready access to the tongue and the floor of the mouth. The method was introduced by Roux in 1836, and has been carried out and modified by Sédillot (1844), Syme (1857), and Billroth (1862).

The Inframaxillary Incision was first employed by Regnoli in 1838. The tongue was reached by an incision along the border of the lower jaw.

The method has been employed and developed by Czerny (1870), Billroth (1871-6), and Kocher (1880).

Circumstances of the Operation and the Question of Hæmorrhage.—The main difficulties encountered in attempting to remove the entire tongue are dependent upon the narrow space in which the operation has to be performed and upon hæmorrhage.

To get over the first difficulty ingenious gags have been invented, and various cheek retractors employed, or the cheek itself has been slit up, or the jaw divided, or the mouth entered by an incision in the suprahyoid or inframaxillary region. It is recognised that the excision, to be satisfactory, must be complete, and to effect this the surgeon's movements must not be hampered.

To cope with the bleeding, the actual cautery, the ligature, and the *écraseur* have been used, or the lingual arteries have been secured in the neck by a preliminary operation.

The Hæmorrhage cannot be said to be great in amount. It proceeds mainly from the two lingual arteries which are divided in the floor of the mouth. The lingual artery is small. The average calibre of the main trunk is only about 3 mm. The artery is usually cut beyond the hyo-glossus muscle, and when it has received the name ranine. The two ranine arteries anastomose by a small loop near the tip of the tongue, but with this exception the right and left linguals only communicate by capillary branches. It is not the extent of the hæmorrhage that troubles the surgeon so much as the locality of the bleeding.

The blood is poured into the mouth, and when even quite small in amount may entirely obscure the area of the operation. The operation is carried on, as it were, in a small cup, and this is soon filled. The blood is apt, moreover, to run back into the pharynx, and find its way into the air-passages. The narrow space within which the surgeon's operations are confined renders the securing of the bleeding-point often a matter of difficulty.

The lingual arteries follow a somewhat upward course in passing from the region of the great cornu of the hyoid bone to the frænum linguæ.

When the tongue has been removed, and these vessels are exposed in the floor of the mouth, it will be found that if the mouth be kept well open the stream of blood which issues from the cut vessels will be directed out of the mouth. The blood, as it spurts from the divided artery, is directed upwards and forwards, and thus under what may be termed natural conditions it is poured out of the mouth rather than into it. Very often, indeed, the jet of blood strikes the surgeon in the face as he is looking for the severed vessel.

The lingual arteries, especially in patients of the age at which cancer operations are usually undertaken, are often brittle, and are a little difficult to secure.

Unless a good view be obtained of the bleeding-point, it is not easy to grasp the artery with forceps without at the same time picking up much muscular tissue.

It must be remembered that when the tongue has been removed a very deep cavity is left in the mouth, and the floor of this cavity may appear far removed.

If all the fingers of one hand be placed on the skin between the lower jaw and the hyoid bone, and if the floor of the mouth be pressed vigorously upwards by the fingers so placed, not only is the cut surface brought well into view, but the hæmorrhage is for the time being controlled.

Or an assistant, placing both his thumbs in the same position, may take hold of the lower jaw with the fingers and force the floor of the mouth up with the thumbs.

To attempt to pick up the bleeding vessels, without first forcing upwards and fixing the floor of the mouth, is to make the proceeding unnecessarily difficult.

While bleeding is taking place into the oral cavity, care should be observed in maintaining a certain position of the head. If the head be thrown back, and the chin be in the median line, all the blood must gravitate backwards to the pharynx and air-passages. This is the position in which the head is not unfrequently found after the excision has been effected. To

minimise the evils of hæmorrhage the shoulders should be well raised, the head should be pushed a little forwards, and should incline to one side, so that the cheek rests upon the table, or is at least the most dependent part. If this be done, all the blood will at first run into the flaccid hollow of the cheek. In old subjects, with tissues relaxed by the anæsthetic, the capacity of this cheek pouch is considerable. The blood can be readily removed from the pouch by sponges in holders, and is often found to have already coagulated.

The position described is not the most convenient for the operator, but it is certainly the safest for the patient.

Extent of the Operation.—Small innocent growths of the tongue, or small portions of the organ can be readily excised with the scalpel or with suitable scissors. If convenient, the edges of the wound may be brought together with sutures. Sutures, however, are seldom necessary, and the wounds do well enough without them. The bleeding may be checked by sponge pressure, or by pressure forceps, or by torsion.

When the extreme tip of the tongue is involved, the part may be excised by a V-shaped incision, the base of the V including the tip of the organ, the apex being at the middle line, some distance from the tip.

The margins of the triangular gap thus left may be approximated by sutures.

Cancer, in the great majority of cases, commences on the lateral aspect of the tongue. Whilst it is still confined to one side of the middle line there is no valid reason for removing the whole organ. Supposing it has infiltrated the anterior portion on both sides, the surgeon may often safely leave a stump formed of the posterior third or less. If the whole tongue be excised the floor of the mouth will ultimately project upwards and take its place to a surprising extent, but articulation is never so good as if a fair-sized stump has been left, and the constant flow of saliva may prove a nuisance to the patient. The general rule may be laid down to cut wide of the cancer, but leave any perfectly healthy part of the tongue. Recurrence is common in the lymphatic glands, rare in the stump of the tongue.

The particular lymphatic glands which are the dangerous

ones with regard to cancer of the tongue may be defined with fair accuracy; they are shown in Fig. 340.

There are one or two lymphatic glands placed in the submaxillary triangle amongst the lobules of the salivary gland, but these are rarely involved in cancer of the tongue. Cancer of the lower lip, however frequently infects these. If the primary growth in the tongue extends far back towards the tonsil, the gland marked *A*, situated under cover of the jaw, is liable to be infected.

But in the great majority of cases the carcinoma starts on the lateral aspect of the tongue, and deposits occur in the glands outside the submaxillary triangle at the junction of the facial and jugular veins, on the outer aspect of the carotid bifurcation, along the course of the main vessels and beneath

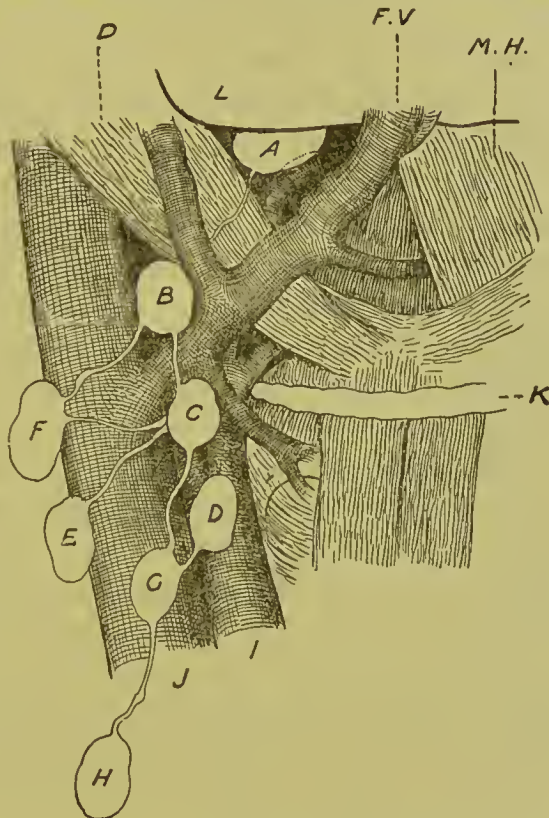


Fig. 340.—GLANDS OF THE NECK IN WHICH CANCEROUS DEPOSITS ARE LIKELY TO OCCUR.

L, Lower jaw; *K*, hyoid bone; *D*, digastric muscle; *M. H.*, mylo-hyoid; *I*, common carotid artery; *J*, internal jugular vein; *F.V.*, facial vein (the facial artery is seen beneath it). The submaxillary gland has been removed. The glands lettered *A* to *H* are those in which cancerous deposits are likely to occur. Of these *B*, *C*, *D*, *E*, *F*, and *G*, over the bifurcation of the carotid and on the jugular vein, are the most important.

the deep fascia (*B*, *C*, *D*, *G*, in Fig. 340). Later on, the glands at the back of the jugular vein (*F*, *E*), or even those lower down (*H*, etc.), become involved. As they soon adhere to the main vessels, their removal at a later stage becomes difficult and dangerous. Hence the operation for excision of cancer of the tongue should include at the same time a

careful and thorough attempt at removal of the lymphatic glands referred to on one or even on both sides of the neck. This can be effected through a modification of the usual incision for ligature of the lingual artery, which is described later.

Should the Submaxillary Gland be Removed?—As already noted, cancerous deposits in this gland rarely accompany epithelioma of the tongue, though the submaxillary gland often is harder than normal owing to a degenerative sclerosis. Its removal complicates the operation to no great extent, but involves ligature of the facial artery and vein, and therefore prolongs the operation. If the primary growth encroaches on the floor of the mouth, it is certainly best to clear the submaxillary triangle, but the mylo-hyoid muscle should be left, to prevent the neck and mouth wounds communicating.

Some surgeons, amongst them Mr. Butlin, advise that the tongue excision should first be carried out, and that the second operation on the glands of the neck should be performed a few weeks later. This course has the disadvantage of submitting the patient to two serious operations at a short interval, and, moreover, loses the advantage of preliminary ligature of the lingual arteries. Provided that the latter vessels have been secured in the neck, a free excision of the tongue may be carried out quickly and with hardly any bleeding, and there is no risk of secondary hæmorrhage.

1. EXCISION WITH PRELIMINARY LIGATURE OF THE LINGUAL ARTERIES, ETC.

With regard to the method of removing the tongue, without doubt the best instrument is a pair of strong scissors. Mr. Walter Whitehead introduced this operation in 1877, and in the *Brit. Med. Journal* of May 2nd, 1891, gave a valuable account of his experience with it. The various forms of *écraseur*, galvanie, cold wire, &c., need only be mentioned to be condemned. They have been entirely superseded by the scissors.

Preliminary Measures.—For some days before the operation every attempt should be made in cancer cases to overcome the foul state of the mouth. For this purpose a wash of

carbolic lotion (1 in 80) may be used hourly, and especially after any food has been taken. Frequent use of tooth-brush and antiseptic dentifrice should be insisted on. All carious or loose teeth should be removed, if possible, a few days before the major operation is done. The incisor teeth in cancer cases are often loose, uncovered by the gum, and foul with tartar.

Better results would be obtained if a moderate amount of care were taken to render the mouth less septic. It is unwise to deliberately carry out any excision in an atmosphere of putrefaction.

The patient's neck and face must be shaved.

Instruments required.—Mouth gag. Curved needle in handle. Stout silk. Tongue forceps. Mouth retractor. Tenaculum. Blunt-pointed scissors, straight and curved. Volsella. Wells's pressure, dissecting, and fine-toothed forceps. Sponges in holders. Ligatures, &c. Scalpels. Retractors. Blunt hooks. Aneurysm needle. Needles and sutures.

The instruments required for the first stage, including ligation of the lingual and dissection of the glands—should be in one dish, whilst those required for the second stage—the actual excision of the tongue—should be kept in a separate dish.

The best gag is Mason's or Hewitt's. It must be strong, and the blades be capable of wide separation. The “catch” fixing the gag when open must be secure. A “catch” is better than a screw.

The best cheek retractor is the broad rectangular retractor used in nephrectomy operations. It is in every way excellent.

The scissors used for cutting out the tongue should be quite straight, and quite flat and strong. They should be longer than the usual pattern, and should end in square blunt points. The cutting edge should extend up to the very tip. Curved scissors should never be used to effect the actual excision.

The Anæsthetic.—Chloroform should be selected, and it is best administered by means of Dr. Hewitt's most ingenious and admirable gag. This consists of a Mason's gag, along the bars of which two small metal tubes run. These open at the mouth end of the gag, and at the handle end are connected with tubes from Junker's chloroform apparatus. The

anæsthetic can be given without the very least inconvenience to the surgeon, and without the area of the operation being encroached upon. I have found Dr. Hewitt's method most satisfactory.

Position.—The patient lies close to the right-hand side of the table. The head and shoulders are well raised, and the arms are folded behind the back. The surgeon stands to the right and the chief assistant to the left. The anæsthetist stands at the head of the table, and by him an assistant who holds the gag and steadies the head. The gag is introduced on the left side of the mouth, is very firmly held, and, with a Mason's gag, it is a good rule to keep the handle of the gag always against the patient's ear.

A good light is essential.

The Operation.—In many cases it is necessary to tie both lingual arteries. The surgeon commences on the side on which the cancerous growth is situated, and that on which the lymphatic glands will therefore require to be dissected out.

During the first stage the gag is not introduced, but it is often convenient to introduce a loop of silk ligature through the middle of the tongue, so that in case the breathing should become embarrassed traction can be made on it.

The patient's head is turned on the side, and kept steadily in this position with the chin raised.

A curved incision is then made from just below the angle of the jaw towards the symphysis; it extends downwards to the hyoid bone (Fig. 341).

A second, nearly vertical, cut is made along the anterior edge of the sterno-mastoid muscle for three inches.

Both incisions are made through skin and platysma muscles, and then more deeply through the fascia.

If it is not proposed to remove the submaxillary gland, the lower edge of the latter is thoroughly exposed, and the whole gland raised upwards with its coverings. This may be done by means of a broad retractor. The external flap is now carefully dissected back and held by a suture retractor. The bifurcation of the carotid artery, and the internal jugular vein lying behind and somewhat overlapping the carotid, are exposed,

and all lymphatic glands that can be discovered in this region are cautiously dissected out (see Fig. 340). This is the most tedious part of the operation, but at the same time the most important. The submaxillary gland being well raised, the tendon of the digastric muscle is drawn downwards with a blunt hook. The posterior edge of the mylo-hyoid is now defined, and the hypo-glossal nerve with the ranine vein are seen passing beneath it.

With blunt dissection the nerve and vein are displaced slightly upwards, particular care being taken not to wound the vein. In the small triangle formed by the nerve, the posterior belly of the digastric, and the posterior border of the mylo-hyoid, the surgeon now incises the hyo-glossus fibres which form its floor. This is done cautiously, the muscle fibres being

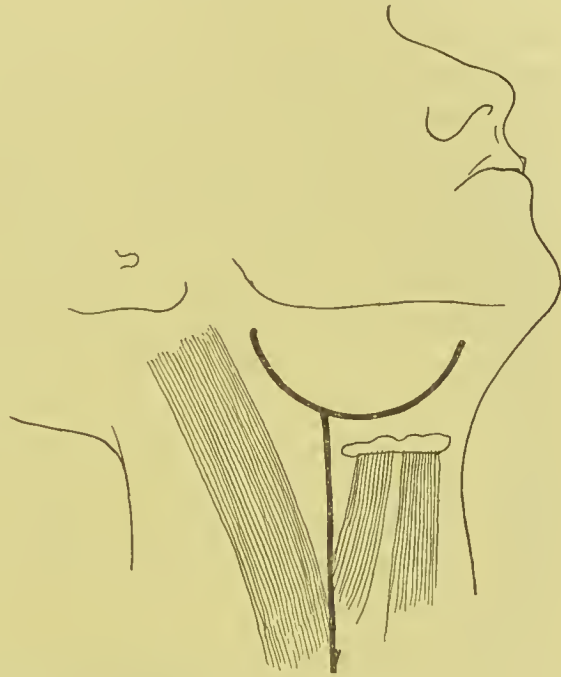


Fig. 341.—INCISIONS FOR LIGATURE OF THE RIGHT LINGUAL ARTERY WITH REMOVAL OF LYMPHATIC GLANDS.

The sterno-mastoid muscle, the hyoid bone and its depressor muscles, are indicated.

fixed by fine-toothed forceps. It is easy to go too deeply and wound the lingual artery, or perhaps to miss it and work in too deep a plane. As a rule, provided that the points mentioned are carefully observed, the artery is found with ease. An aneurysm needle is passed from below round the artery, and the latter securely tied. The submaxillary gland is then replaced, all bleeding points are secured by catgut ligatures, and the wound is quickly sewn up with silkworm gut. It is usually best to leave a small drainage-tube in the lower angle of the wound;

Supposing that the epithelioma is wholly marginal, and

there is no need to remove more than one half of the tongue, the operator now proceeds to deal with the latter, after securing an aseptic dressing on the neck wound. In some cases, however, it will not be safe to limit the excision to one half the tongue. The patient's head is then turned to the opposite side, and the other lingual secured.

A temporary dressing has been secured around the neck, the instruments previously required are put aside, and the anæsthetist arranges to give chloroform through Junker's inhaler with a metal tube (or by means of Hewitt's gag).

The operator stands on the right side of the patient, the gag being inserted on the left. The assistant must be provided with plenty of small pieces of sponge mounted in holders, and the position of the gag must be carefully supervised—otherwise it is apt to slip forward. The instruments must be placed within easy reach of the operator, who will usually find it convenient to stand on a stool, so that he can look down into the back of the patient's throat. When the gag is opened it often happens that the breathing becomes obstructed and the patient somewhat cyanosed: this condition should be relieved by traction on the tongue, made with the ligature and by holding the jaw forwards.

With vulsellum forceps in the left hand and scissors in the right, the operator now excises the affected area of tongue. He must divide the mucous membrane at a considerable distance from the edge of the epithelioma, and continue the incision so that a large margin of healthy tongue is removed with the growth. Sometimes it is necessary to remove the entire organ, in other cases only one half; in some a wedge-shaped piece is removed. The bleeding, provided the lingual arteries have been properly secured, is mainly venous and insignificant in amount. Wells's forceps should be applied, in case any vessel spurts. By turning the patient's head on one side, and by careful sponging, the blood should be entirely prevented from running down the throat.

When the surgeon is satisfied by inspection that all hæmorrhage is arrested, and that the growth has been freely excised, the gag is removed. The neck dressing is again seen to, and a

piece of macintosh secured over it so as to prevent it from being soiled.

Until the patient comes round from the anæsthetic, he should be kept lying somewhat on the side, and a nurse should use a mounted sponge from time to time in the mouth. When he has come round the head and shoulders should be well supported by pillows, as venous oozing will be diminished by this means.

Comment.—With regard to obtaining free access to the mouth during the excision, the gag and cheek-retractor usually suffice. The gag should be on the side away from the growth when the latter is unilateral. If these measures do not suffice, and especially if the epithelioma encroaches on the jaw, the cheek may be split and subsequently sutured. Invasion of the alveolar margin may necessitate excision of part of the bone by chisel and gouge, together with removal of the sublingual gland and other soft parts at the floor of the mouth.

If the submaxillary gland be removed, the preliminary stage requires to be slightly modified. The platysma and fascia are dissected off the gland and held upwards; the facial vein and artery are exposed at the lower and posterior corner of the gland. Both vein and artery are then ligatured and divided. The gland, with one or two contained lymphatic glands, is then dissected out and drawn forwards, the facial vessels being again secured as they pass over the jaw. The prolongation of the gland along Wharton's duct is drawn out from beneath the mylo-hyoid muscle, and a ligature should be put round the duct before it is divided (to prevent possible contamination of the wound by backward flow of saliva). A lymphatic gland lying under the angle of the jaw (*see A*, Fig. 340) should be removed at the same time.

Whenever the submaxillary gland is removed, a drain should be left for a day or two; otherwise blood collects in the space. Before sewing up the wound the surgeon should make certain that his ligatures on the divided facial vessels are holding well.

The method described above combines the advantages of preliminary ligature of the lingual arteries with excision of the lymphatic glands most likely to be involved by epitheli-

omatous deposit. When recurrence takes place after excision of the tongue, it is usually met with not in the stump, but in the glands. At the time of operation it will frequently be found that glands which lie under the sterno-mastoid, and which could not be plainly felt, contain small secondary deposits. Nevertheless, some surgeons prefer to excise the tongue without preliminary ligature or dissection in the neck. The following description is based on Mr. Whitehead's account.

2. EXCISION WITHOUT PRELIMINARY LIGATURE.

A firm ligature is passed through the anterior portion of the tongue for the purpose of traction. Much depends upon the care of the assistant to make the traction in the right direction and at the right time.

The first step in the actual operation consists in the separation of the tongue from its attachment to the floor of the mouth and the anterior pillars of the fauces. The ease with which the operation is continued depends largely upon the freedom with which this separation is carried out. The two structures principally responsible for the retention of the tongue within the mouth are the frænum and the anterior pillars of the fauces; and, if these are completely divided in the first instance, the tongue may be so freely drawn from the mouth that the operation is practically converted into an extra-oral excision. "Extended practice," writes Mr. Whitehead, "has made me conduct this part of the operation with less deliberation and more rapidity than was my habit in my earlier cases. Instead of the cautious snipping I originally advocated, I now boldly cut until I get close to the vicinity of the main arteries, disregarding all bleeding, unless an artery distinctly spurts, when I twist it and proceed. The more profuse the general oozing, the more rapidly I proceed, my object being to get as quickly as possible to the main arteries, as I have confidence that all subsidiary bleeding will cease immediately after their division. There is, in reality, no difficulty in determining the actual position of the lingual arteries, as they are practically invariably found in the same situation, and it requires very little experience to seize them with a pair of forceps before dividing them; if this be done there need not be the slightest hæmorrhage from this source. When once the vessels are effectually twisted, the rest of the tongue may be removed without any further anxiety about hæmorrhage; but it is desirable, before finally severing the last attachments, to pass a loop of silk through the glosso-epiglottidean fold, as a provisional measure of security, in case it may become necessary to make traction on the posterior floor of the mouth, either to assist respiration, or to arrest any possible consecutive hæmor-

rhage. Traction on this ligature of itself arrests hæmorrhage, and makes it an easy matter to secure any bleeding vessel. As the retention of this ligature is a source of some annoyance to the patient, I always remove it at the end of twenty-four hours." Strong straight blunt-ended scissors are employed.

After the tongue is removed, the floor of the mouth is washed with a solution of biniodide of mercury (1 in 1,000), is well dried, and is then painted with an antiseptic "varnish" introduced by Mr. Whitehead. This varnish contains the ordinary ingredients of friar's balsam, and differs from it in the fact that for the rectified spirit is substituted a saturated solution of iodoform in ether. With the ether is mixed one volume in ten of turpentine. This varnish dries immediately, and leaves a firm coating on the wound which lasts for twenty-four hours, and produces no irritation. It also acts as an admirable styptic.

Some surgeons simply dust the floor of the mouth with iodoform. Others resort to the objectionable practice of stuffing the mouth, or at least the lower segment of it, with gauze. I have dispensed with applications of any kind. The mouth is well washed out with an antiseptic lotion, and is left. It must be remembered that the discharge of saliva is fairly copious, and renders any "dressing" almost immediately ineffective.

Comment.—I think that the ligature left in the glosso-epiglottic tissues may well be dispensed with. As has been already pointed out (page 183), there is no difficulty in bringing the floor of the mouth into view in case of secondary bleeding.

When the disease involves the frænum, it is well—as Mr. Jacobson points out—to extract two or three of the lower incisors. If this be not done, it is very difficult to obtain a clear field for the scissors, and a complete excision of the implicated tissues may be found to be almost impossible.

3. KOCHER'S OPERATION.

This method was first described by Kocher in 1880 (*Deutsche Zeitschr. f. klin. Chir.*, Bd. 13, page 147), and has been especially advocated in England by Mr. Barker. Professor Kocher has, however, entirely abandoned the method known by his name in favour of Syme's operation (median division of the lower jaw followed by excision of the tongue. *See* Kocher's "Operative Surgery," 1902 edition).

The patient having been placed in position, a preliminary tracheotomy is performed.

An ordinary cannula is employed, and the pharynx is

plugged with a clean sponge, which has been wrung out in carbolic lotion, and to which, as a security, a long silk thread is attached.

The mouth will have been already as well cleansed as is possible, and should have been very frequently rinsed out with some antiseptic solution.

Chloroform is administered through the tracheal tube.

An incision is made in the neck. It commences just below the lobule of the ear, and runs along the anterior border of the sterno-mastoid muscle.



Fig. 342.—REMOVAL OF THE TONGUE.

A, Incision for splitting the cheek; B, Kocher's incision.

When the middle of this border of the muscle has been reached, the incision is carried forwards to the hyoid bone, and thence to the symphysis along the anterior belly of the digastric muscle (Fig. 342, B).

The flap thus marked out is turned upon the cheek. The facial vessels are ligatured, as is also the lingual artery before it passes beneath the hyoglossus muscle. The submaxillary fossa is now evacuated,

the surgeon working from behind forwards. All the lymphatic glands of the region are removed, and also the sublingual and submaxillary salivary glands, should the diseased tissue be in near association with them. The mylo-hyoid muscle having been cut through as far as is needed, the mucous membrane is divided close to the jaw, and the tongue drawn out through the opening.

The tongue may now be slit in the middle line, and one half removed with scissors.

If the whole tongue needs to be removed, the lingual artery of the opposite side must be ligatured through a separate incision.

The skin incision is not closed by sutures, but the whole

wound is left open, and its cavity is plugged with gauze or with a sponge wrung out in carbolic lotion.

The wound is allowed therefore to close by granulation, while the freest possible vent is provided for the escape of all discharges.

The tracheotomy tube is retained until the wound is granulating healthily. It thus happens that the patient breathes fresh air throughout the most important period of the after-treatment, or, at least, the air inspired has not passed through the mouth and over the wound surface.

Comment.—This operation has the great drawback of a large wound in the neck, into which saliva and septic discharges soak for some days, and the tracheotomy in itself is an addition to the operation of excision of the tongue which should and can be dispensed with in the great majority of cases. The mortality of the operation in the most practised hands has been heavy.

4. OTHER OPERATIONS.

A. Excision after Division of the Lower Jaw. — The operation of Roux, Sédillot, or Syme.

The soft parts are divided in the median line by an incision which bisects the lower lip, traverses the chin, and ends at the hyoid bone (Fig. 343, A). All bleeding having been arrested, one of the lower central incisors is extracted, and two holes are drilled through the jaw below the level of the teeth, each hole being about a quarter of an inch on either side of the median line.

The jaw is now divided as near to the middle line as possible. The section may be vertical, or may be slightly serrated, so that after the excision the two portions of the jaw may be to some extent interlocked.

The two halves of the jaw are held asunder by assistants while a stout silk ligature is passed through the tongue—in the manner already described (page 188)—and by means of this thread the organ is drawn well forwards and upwards.

The floor of the mouth is opened up. The mucous

membrane between the tongue and the alveolus is divided with seissors; the genio-hyoid and genio-hyo-glossi muscles are then cut with the same instrument.

The excision of the tongue is carried out with the seissors. The tissues entering the under-surface of the tongue are divided in order from before backwards, and all bleeding vessels are at once secured. The operator should endeavour to ascertain the position of the lingual arteries, and each artery may be grasped with pressure forceps before the section is carried beyond the vessel. It is well that one artery should be secured before the other is cut. It is better to conduct the operation slowly, and to proceed step by step, rather than to attempt to slash the tongue away boldly by one or two vigorous cuts with a bistoury.

A very convenient plan is to split the tongue, and remove one half at a time. While the first lingual is being dealt with the tongue is held forwards by means of the intact half; and while the second artery is being dealt with, the stump may be drawn forwards by the forefinger, which is hooked, as it were, in the pharynx.

As much of the tissues in the floor of the mouth as appears to be involved must be removed.

Bleeding arteries should be secured by torsion rather than by ligature.

The two halves of the jaw are wired together by a stout silver wire passed through the two holes.

The wound is closed by sutures, and a drain is introduced into its lower angle.

A gutta-percha cap may be fitted to the chin to prevent displacement of the divided bone.

Precautions should be taken to prevent the falling back of the stump, which is apt to occur when the attachments of the hyoid bone to the jaw have been extensively divided. This complication may be met by securing the tissues of the stump to the tissues at the sides of the mouth by two or more silk-worm gut sutures. These sutures may be allowed to cut their way out in the course of time.

In certain cases, in order to effect a more complete removal

of the cancerous parts, portions of the jaw have been excised together with the tongue. In these instances the implication of the floor of the mouth has been very decided. These operations are extensive and serious, and before a surgeon undertakes so grave a measure he should be quite convinced that the disease has not extended so far as to render a complete and satisfactory excision almost impossible.

B. Excision after Division of the Cheek.—This method has been employed by Jaeger (1857), Maisonneuve (1858), Collis (1867), Sir William Stokes, Furneaux Jordan, Gant, and others. The incision made in the cheek is a curved one, and extends from the angle of the mouth to the anterior edge of the masseter muscle (Fig. 342, A). It has been modified in many unimportant ways.

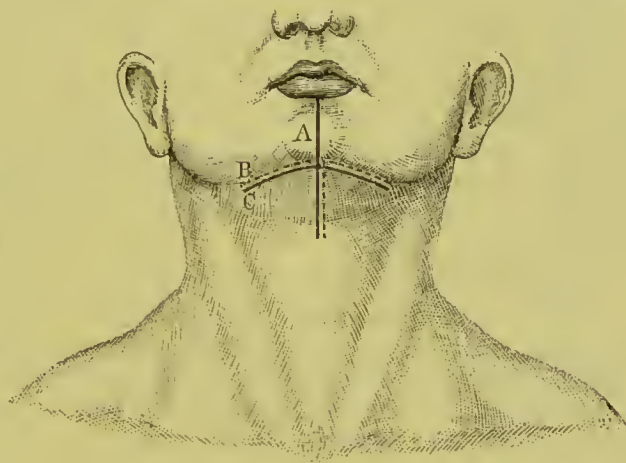


Fig. 343.—REMOVAL OF THE TONGUE.

A, Incision of Syme, Roux, Sédillot; B, Regnoli's incision; C, Billroth's incision.

A straight blunt-pointed bistoury is used in the making of the incision. While the cut is being made, an assistant grasps the tissues of the cheeks above and below the line of the incision with the thumb and forefinger of each hand. In this way the bleeding, which is disposed to be very free, is controlled. All the divided vessels must be well secured before the operation is proceeded with.

The two flaps of the cheek are now held well aside, and a gag having been introduced, the excision of the tongue is carried out through the large opening which has been obtained.

c. Regnoli's Operation.—Regnoli's account appeared in 1838 (*Bull. delle Scienze Med. di Bologna*).

An incision is made in the median line of the neck from the lower margin of the symphysis to the centre of the hyoid bone.

Two lateral incisions extend outwards from the upper end of the median cut, and follow the lower border of the jaw as far as the anterior border of the masseter muscle (Fig. 343, B). The facial artery is not divided. The two flaps thus marked out are dissected up, and contain skin, cellular tissue, and platysma. A straight sharp-pointed bistoury is thrust from below upwards behind the symphysis, and into the mouth so that the point appears behind the incisor teeth. It is withdrawn, and a straight blunt-pointed bistoury is introduced in its place. The insertions of the genio-hyoid and genio-hyo-glossal muscles are severed.

The knife is then made to divide the anterior insertions of the digastric and mylo-hyoid muscles, and the mucous membrane of the mouth as far back as the anterior pillars of the fauces. Such vessels as are divided are secured. The tongue is now seized, and is dragged forcibly through the opening, and is then excised by means of scissors, the same precautions being observed with regard to the lingual arteries as are described in the account of Syme's operation (p. 196). It may be necessary to take steps to prevent the falling back of the stump. These have been already alluded to (p. 196).

A drain having been introduced, the wound is closed.

This operation has been modified in many ways. Billroth omitted the vertical part of the cut, and carried the curved submental incision much farther backwards on both sides, so as to be able to ligature one or both lingual arteries before extirpating the tongue and any affected glands that may exist (Fig. 343, C).

THE CHOICE OF AN OPERATION.

Many decided and yet very opposite views have been expressed upon the question as to which is the best method of excising the tongue.

Each surgeon will commend the operation of which he has personally most experience and with which he is most familiar. This somewhat conservative attitude is not weakened by the fact that it is difficult to show by statistics that one particular method—among the more modern operations—is pre-eminently the most satisfactory and the most successful. Whitehead's operation, in the hands of Mr. Whitehead, has been attended with very admirable results, and it would be unfair to consider this particular excision as of slight value simply because another surgeon obtains less satisfactory results in his few attempts at removing the tongue with scissors. It would appear that in

Koeher's operation better results have been obtained by the author of the method than by any other surgeon who has followed him.

In choosing a method of excising the tongue, it is obvious that much must be left to the training and inclination of the individual surgeon, and that in giving advice to the student it may be excused if the advice is a little biassed by a personal and possibly somewhat restricted experience.

The three principal methods of operating are those first considered in the above account.

The operations dealt with in Section 4 have little to commend them.

I would venture to urge the following propositions in connection with the operation of excision of the tongue:—

1. The organ should be removed by cutting, *i.e.* either with seissors or with the bistoury.

2. The removal should, as a general rule, be effected through the mouth.

3. Every means should be taken to reduce the hæmorrhage to a minimum.

4. When the floor of the mouth is involved, or the glands are extensively involved, the excision should be carried out through the neck.

The wound made by a surgeon should be a clean cut—an incised wound. Such a wound accomplishes its end with the least possible amount of injury to the parts involved, and such a wound is made with the scissors or the scalpel.

The use of the *écraseur* is to be condemned.

The instrument is barbarous and obsolete, and is not in conformity with the principles of modern surgery. It represents the most slovenly and the least efficient method of removing a part. It has the one advantage that its employment involves neither skill, judgment, nerve, nor education.

As a surgical undertaking *excision by the écraseur* has about it a distinct air of senility.

In the place of the clean cut it leaves a wound of almost the worst kind, *viz.* a lacerated and contused wound; and inasmuch as septic pneumonia represents the chief risk after

these operations, a needless element of evil is introduced into the measure. The loop, as usually applied, is difficult to direct and difficult to maintain in place. The diseased tissue cannot be removed in any way that is desired. It must be removed upon a stereotyped plan. The loop directs the excision line. It must be a regular line, and the surgeon cannot depart from it. It is easy for the loop, under the great tension placed upon it, to encroach upon the cancerous district and leave some of the implicated tissue behind. The *écraseur* can but feebly imitate the deliberate and intelligent and exact excision which can be accomplished with the scissors or the scalpel.

The use of this uncouth instrument is excused upon the ground that it renders the operation bloodless. In the Middle Ages the *écraseur* would have been a useful apparatus, but since that period certain methods of checking bleeding have been introduced, and these can be as well applied to the cavity of the mouth as to the palm of the hand.

Even an exaggerated terror of hæmorrhage, and a sense of incompetency in dealing with it, afford no excuse for leaving in the mouth a wound that must in a few days exhibit a sloughing surface.

The galvanic *écraseur* has been so generally condemned in these operations, that it only remains to regret that it is still occasionally employed. It has all the disadvantages of the simple *écraseur*, with the additional evils that it leaves a still fouler wound, and is peculiarly prone to be followed by secondary hæmorrhage. In six cases of removal of the tongue by the galvanic *écraseur*, mentioned in the report of the London Hospital (1889), secondary bleeding occurred in three. Mr. Barker states that out of sixteen excisions with the galvanic loop at University College Hospital, eight patients died.

Removal through the mouth involves no wound beyond that made in the tongue. I have met with very few cases in which *splitting of the cheek* appeared to be called for. Mr. Butlin states that division of the cheek is of immense advantage in cases of extensive disease. More room is obtained, a better light is afforded, as well as a better command over

the stump of the tongue. It is open to question whether these advantages may not be obtained in other and more satisfactory ways.

Syme's Operation is quite needlessly severe, and needlessly complicated. The after-treatment is of long duration, and trouble often arises from the divided bone. As the attachments of the tongue to the hyoid bone are extensively divided, the stump is apt to fall back, and the control over the larynx may be so modified that the patient is less well able to prevent discharges from running into the air-passages.

The last named of these objections may apply to *Regnoli's Operation*. It gives good access to the floor of the mouth, and may be employed when the tip of the tongue and the anterior part of the floor of the mouth are involved. It fails, however, to provide an equally free access to the base and lateral parts of the tongue. Billroth's modification of this operation has distinct advantages over the parent method.

Of the *three selected methods of excision* (viz. excision after ligature of the linguals, Whitehead's operation, and Kocher's operation), I would venture to think that the excision of the tongue after securing the linguals at the neck is the best operation in the usual run of cases, and that Kocher's operation may be with advantage employed when the glands are much involved, and especially when one side of the floor of the mouth has been invaded. Of the value of Whitehead's operation there is, however, no question.

The possible advantages of the method of *excision after securing the linguals* over Whitehead's method are these :—

In the former operation the excision can be conducted very safely and easily. There is no pool of blood on the floor of the mouth to obscure the surgeon's movements, and the excision can be carried out with great accuracy and precision. In *Whitehead's operation* the bleeding may be copious and sufficiently free to hamper the surgeon's movements and to complicate the operation. To an inexperienced operator the bleeding may be alarming, and may lead to hurried and incoherent action. The fact that the hæmorrhage is readily controlled

does not render it the less troublesome or a less serious complication during the actual excision.

The advantages of the method by securing the linguals are not limited to the one feature of rendering the operation almost bloodless, and relieving the surgeon of all anxiety as to hæmorrhage. In cutting down upon the arteries the submaxillary lymphatic glands are exposed, and may be removed if found to be enlarged. I have often excised glands which were discovered during the operation, but which were not to be felt through the skin before the operation was commenced. If necessary, also, the floor of the mouth can be opened up and the submaxillary gland, which is not unfrequently adherent to the diseased tissues, can be removed with the greatest readiness.

It has been said (1) that the preliminary ligature of the linguals adds to the dangers of the excision ; (2) that it involves a difficult operation which consumes a great deal of time, and (3) that the bleeding may be as free after the linguals have been secured as it is when no such precaution is taken (Jacobson).

My answer to these objections is as follows :—

1. I find, from the Register of the London Hospital (1891), that I have removed the entire tongue with scissors (after ligaturing both linguals in the neck) thirty-four times. Of these thirty-four patients two only died from the operation (one of pneumonia, the other of pyæmia). A third patient, with aortic and mitral disease, died suddenly very shortly after the operation, but it would be scarcely just to ascribe this death to this particular excision. These figures will show that the operation is not unduly dangerous. I might add that I have had no death from this operation in private practice.

2. I have ligatured the lingual artery in considerably more than sixty-eight instances (*i.e.* both arteries in the thirty-four cases). The operation is easy, and both linguals can be secured within fifteen to twenty minutes. Since attention was drawn to the length of time involved in this operation, I have noted that seven minutes represents a fair period of time within which the ligature of one vessel may be completed.

3. With regard to the third objection, I can only add that

in no instance in which I have ligatured both arteries have I found any bleeding which caused the least inconvenience, and very little that called for any treatment.

I have known other structures to be ligatured in the place of the lingual artery, and the bleeding as a consequence to have been very free, "as free as in the usual operation with scissors." It is by no means difficult to make a mistake in securing this small and deeply placed vessel.

The anatomy of the tongue is simple, and is well known; the anastomoses of the lingual arteries have been thoroughly demonstrated, and my experience has distinctly taught me that if both lingual arteries are securely ligatured as they pass beneath the hyo-glossus muscle, the bleeding from the stump of the tongue will be arrested.

Kocher's Operation is severe, and involves a wide opening up of the connective tissue of the neck.

It appears to be somewhat too extensive for the ordinary case of excision of the tongue, and many surgeons may be inclined to dispense with the preliminary tracheotomy.

The incision can be carried out easily and completely, and the hæmorrhage can be kept well under control.

The operation is well suited for cases in which the tongue is affected far back, in which diseased glands exist, or in which the floor of the mouth is involved upon one side. The resulting wound can be kept clean, but the after-treatment is tedious. In one very successful case reported by Mr. Barker (*Lancet*, October 15, 1887) it is noted that the patient continued to be fed with a tube for sixteen days after the excision.

AFTER-TREATMENT.

In a case of excision of the tongue after ligature of the linguals in the neck, the following treatment is carried out:—

Nothing is applied to the mouth at the time of the operation. The slight oozing, and the salivation which continues for some hours after the excision, render an application of little avail. When the mouth is fairly dry, its floor is dusted over with iodoform.

The patient is encouraged to sit up in bed as soon as possible. Morphia should be avoided whenever it can be: it dulls the reflex sensibility of the patient, and may cause him to allow fluid to run down into the air-passages.

The man must be impressed with the importance of allowing all discharge to escape from the mouth, and of swallowing none of it.

The mouth must be kept constantly washed out. This rinsing of the mouth cannot be too frequently performed. Every half-hour in the day, and three or four times in the night, are not too often. The best wash is earbolic lotion (1 in 60 to 1 in 80).

After certain of the washings, say three or four times a day, the floor of the mouth is dried with a pledget of cotton-wool, and iodoform is dusted over the raw surface. It soon forms a more or less consistent pellicle over the stump. A watch must be kept for the symptoms of iodoform poisoning.

During the first twenty-four hours the patient may be fed *per rectum*, and ice only should be taken by the mouth. The use of ice should be very moderate, as it does little but fill the mouth with fluid, which gives the patient some trouble to get rid of. At the end of twenty-four hours, the patient should swallow food. It is best given with an ordinary feeder, while the man sits upright, with his head inclined to one side.

The difficulty of swallowing is usually got over with a little patience and practice. Should the patient be quite unable to swallow, then he must be fed with an œsophageal tube.

One feature in the after-treatment of these cases must not be lost sight of. *The patient must be well fed.* As soon as enough nourishment is taken *per os*, the nutrient enemata may be discontinued. After every occasion upon which food is taken, the mouth must be well washed out.

Now and then the cavity may be flushed out with an irrigator. These operation cases demand the undivided attention of two nurses, one for day duty and one for night, for upon the careful nursing of the case as much of the success depends as upon the operation.

No drainage of the mouth cavity is needed in these cases. If the part becomes unduly offensive, a stronger solution of carbolic acid must be used, and the mere rinsing out of the mouth must be replaced by a flushing out of the cavity with the irrigator.

These perpetual washings-out of the mouth involve considerable annoyance to the patient, but they are necessary only for a few days, and it must be borne in mind that the usual cause of death after these operations is septic pneumonia.

The wounds in the neck are treated in the usual way. They almost invariably heal up by first intention.

The patient may be allowed up on the third or fourth day, and in the majority of the cases I have treated at the London Hospital the patient has left the hospital between the seventh and the tenth day after the excision.

I have been very much disappointed with a solution of permanganate of potash as a wash, and have long since given it up. Boracic lotion is still more ineffective.

Some surgeons, notably Woelfler, have advised that the floor of the mouth be packed with iodoform gauze. I have tried this dressing, but cannot recommend it. It was employed by Mr. Butlin in one case, and the patient died of septic pneumonia. Mr. Whitehead tried it also in one case, and the patient swallowed the dressing.

Mr. Whitehead employs the varnish with which his name is associated (page 193). He does not encourage his patients to consider themselves invalids. They get up on the day after the operation, and may on that day take open-air exercise. Food is administered by the mouth on the day after the excision. In the matter of rapidity of recovery, Mr. Whitehead's cases stand pre-eminent.

Kocher and many others advise that the patient be fed with a tube, to prevent any of the nutriment prescribed from lodging in the mouth and decomposing there. I would venture to think that the tube should only be employed in those few cases in which the patient appears to be really unable to swallow. Even in such instances the sooner it is abandoned the better.

The wholesale cauterisation of the wound immediately after

the operation, with pure carbolic acid, a strong solution of ehloride of zinc, or powdered permanganate of potash, cannot be other than condemned. It is purposeless, and attended with intense pain.

The after-treatment of these cases involves three great factors :—

1st, Let the patient be well fed.

2nd, Let all discharges escape from the mouth.

3rd, Keep the cavity of the mouth clean and sweet.

After-results.—It is estimated that the duration of life in cases of cancer of the tongue, when no treatment is carried out, is twelve to eighteen months.

It has been clearly shown that even when recurrence occurs after excision, the patient's life has been prolonged, his more distressing symptoms relieved, and his comfort greatly added to.

Taking excision of the tongue generally, the mortality of the operation is now probably below 10 per cent.

Not many years ago the mortality was 30 per cent., and between the years 1860 and 1880, Billroth gives the mortality as 22·0 per cent.

Mr. Butlin thus analyses seventy cases of excision for cancer :—

8	died of the operation.
19	were lost sight of.
32	died of early recurrence.
5	were alive up to periods varying from some months to over two years.
6	were alive more than three years after the operation.

70

If the three years' test be applied to these cases, the number of patients "cured" out of the seventy would be represented by 8·5 per cent.

Individual statistics are of little value as means for comparison.

Whitehead has removed the tongue for cancer 139 times (in 104 of these the excision was effected with seissors), with 20 deaths. A mortality of 19·21 per cent.

I had excised the entire tongue with seissors, after a preliminary ligature of the linguals in the neck, thirty-four times at the London Hospital up to the year 1891. Three patients,

as I have said, died, and of this number one died suddenly from heart disease. Thirty-eight similar excisions of one-half or the whole tongue in my (J. H.'s) hospital cases resulted in four deaths. The total mortality would therefore be seven out of seventy-two cases, *i.e.* 10 per cent.

Nine cases of removal of the tongue with the wire *écraseur* performed at the London Hospital between the years 1885 and 1889 resulted in three deaths and one case of secondary hæmorrhage.

The most usual cause of death has been septic pneumonia, and after that pyæmia. A few have died of cellulitis, erysipelas, exhaustion, etc.

CHAPTER VI.

REMOVAL OF TUMOURS OF THE TONSIL.

THE growths concerned in these operations are usually either epitheliomata or round-celled sarcomata.

The malignancy of these tumours, their rapid growth, the early implication of the lymphatic glands, and the deep position of the tonsil, have rendered all attempts to remove them unsatisfactory.

Nevertheless, although recurrence of the growth is the rule, its excision, together with that of all the lymphatic glands which drain from it, should be carried out in all cases in which even a few months' respite may reasonably be anticipated. In almost every case which comes under the surgeon there are already secondary deposits in the lymphatic glands, especially those situated at the angle of the jaw and lying deeply over the bifurcation of the carotid artery. The excision of these glands should form the first stage of the operation, and at the same time the external carotid artery should be ligatured as a rule. The tonsil itself is very vascular, receiving blood from the tonsillar and palatine branches of the facial artery, from the descending palatine branch of the internal maxillary, from the dorsalis linguæ of the lingual, and from the ascending pharyngeal.

The arteries named are branches of the external carotid, and a preliminary ligature of the latter will prevent hæmorrhage from all of them, except the ascending pharyngeal, the origin of which will probably be below the ligature. It may be tied separately. I (J. H.) have known the removal of a large sarcoma of the tonsil from inside the mouth to be almost bloodless, the external carotid having first been secured.

The tonsil is in relation externally with the superior

PART VIII.] *EXCISION OF TONSILLAR TUMOURS.* 209

constrictor, and corresponds, as regards the surface, to the angle of the lower jaw.

The internal carotid is about four-fifths of an inch to the outer and posterior aspect of the tonsil, but may be brought near to it when the vessel is tortuous. The faeial artery, also when tortuous, may be brought close to the front border of the tonsil. Of important eervieal struetures, the nearest to the tonsil is the glosso-pharyngeal nerve. The aseending pharyngeal artery is also in near relation with it.

A tumour of the tonsil may be removed through the mouth or through the neck (pharyngotomy).

By either method preliminary tracheotomy may be dispensed with, though the instruments for it should be at hand.

1. OPERATION THROUGH THE MOUTH.

A loop of silk ligature should be passed through the middle line of the tongue, so that traction can be made on the latter when desired.

The patient's head being turned towards the opposite side, the usual incision (somewhat prolonged) should be made for ligature of the external carotid, this vessel being secured as near to its origin as possible. Through this ineision all lymphatic glands felt to be enlarged, together with any others that can be discovered, are earefully dissected out. The wound is then sewn up.

The patient's head and shoulders must now be well raised, and the best possible light obtained.

A Mason's gag is introduced upon the side opposite to the affected tonsil, and the mouth is as widely opened as is possible. The excision should be effected by long straight scissors, similar to those used for Whitehead's operation on the tongue. The growth may be fixed by long slender forceps of the dissecting-room pattern (but with toothed points), or by a tenaeulum.

If it appears that suffieient room cannot be obtained through the mouth, the ehcek must be slit up as far as is neecessary. In effecting this division the facial artery will be severed.

The operator now proeeeds to earry out the excision. In

the case of a sarcoma, the growth (when the mucous membrane has been divided over it) may sometimes be shelled out with comparative ease, the surgeon using his forefinger, and supplementing its action with a broad periosteal elevator.

When the growth cannot be dealt with in this way, it must be removed by cutting with the scissors.

In carrying out the excision the operator may encroach upon the palate or approach the tongue.

The mass should be drawn well into the mouth, and its excision should be effected deliberately and precisely, and without undue haste.

Bleeding may be checked by sponge pressure or by pressure forceps, or by torsion.

The use of the *écraseur* in such cases is to be condemned, and an attempt to remove the mass with the galvanic cautery or with Paquelin's cautery is needlessly dangerous. By using the cautery in this deep cavity, it is probable that the growth would be but imperfectly removed, while great risk would be incurred of producing eschars on the walls of adjacent blood-vessels, and of establishing conditions favourable for secondary hæmorrhage and for septic processes.

2. OPERATION THROUGH THE NECK (PHARYNGOTOMY).

A. Cheever's Method.—An incision some three or four inches in length is made along the anterior border of the sternomastoid muscle from the level of the lobule of the ear to below the level of the tumour. A second incision is made at an angle to the first along the body of the lower jaw.

The flaps of skin bounded by these incisions are drawn aside, and a dissection is carried down to the tumour.

In dividing the superficial structures, the commencement of the external jugular vein will probably be severed. The fascia must be well opened up. The lower branches of the facial nerve will be encountered. The stylo-hyoid, stylo-glossus, stylo-pharyngeus, and probably the digastric muscles, will need to be divided.

The faeial artery and vein cross the area of the wound, and must be ligatured and divided.

The submaxillary gland is drawn forwards, the parotid upwards.

The internal jugular vein and internal earotid artery will be exposed, and must be drawn outwards with retractors.

The dissection terminates at the pharyngeal wall.

The tumour is now reached, and is removed with the sealpel or seissors, together with the portion of the pharyngeal wall to which it is attached.

The use of the actual cautery in these cases is to be eondemned.

Any enlarged gland met with during the dissection may be removed. The skin-wound is elosed and a drain inserted.

In the place of the ineision along the ramus of the jaw, Mr. Golding Bird slit up the cheek, and was in that way enabled to approach the growth from both sides (*Clin. Soc. Trans.*, vol. xvi., page 9).

B. Czerny's Method.—A tracheotomy is performed, and the air-passage occluded by Trendelenburg's tampon-eannula, or by some other means. (*See* page 150.)

An ineision is inelined downwards and outwards from the angle of the mouth to the anterior border of the masseter, and thence to the level of the hyoid bone.

The lower jaw is exposed, and is divided just in front of the last molar, the saw-cut following the same inelination as the skin incision. The two portions of bone are held well aside. The following museles will need to be divided:—Buceinator, digastric, stylo-glossus, stylo-hyoid, stylo-pharyngeus. The following vessels will need to be secured:—The faeial artery and vein, and probably the lingual and its vein. Care must be taken of the salivary glands, and of the lingual, hypo-glossal, and glosso-pharyngeal nerves.

The tumour is removed with the sealpel or seissors. The two fragments of the jaw are adjusted by silver sutures. The skin wound is closed, and also the wound in the mucous membrane of the cheek (as far as is possible).

A drainage-tube should be employed.

Better access to the tonsil will be obtained if the incision is made to start not from the angle of the mouth, but from the tip of the mastoid process. From the angle of the jaw a small incision downwards may be added in order to remove the lymphatic glands, or upwards to facilitate division of the jaw. The latter should be drilled through for passage of the silver wire before the saw is used, as it is otherwise awkward to use the drill. The line of section of the bone should pass obliquely downwards, forwards, and outwards, so that the fragments shall present a bevelled edge to favour their subsequent union.

Comment.—These operations on the tonsil have, up to the present time, proved very unsatisfactory. There are the difficulties—first of treating the cases early enough; and, secondly, of effecting a complete removal.

The intra-oral method should be attempted when the growth is quite small and easily defined. In all other instances, especially where there is any glandular implication, the pharynx should be opened from the neck. If there be extensive gland disease, any operation will probably be quite unjustifiable.

Mr. Butlin gives the following as the results of twenty-three operations for the removal of malignant tumours of the tonsil:—Three died from the operation; three were lost sight of; ten perished from rapid recurrence, and four from somewhat later recurrence; three only were alive at periods respectively of four, twelve, and twenty-four months after the operation.

Less gloomy results are recorded by Professor Watson Cheyne, who discusses the subject fully in his work on “The Operative Treatment of Malignant Diseases,” 1900.

The **After-treatment** of these cases resembles that carried out in the more extensive operations for the excision of the tongue (*e.g.* Koehér’s operation, page 194).

The mouth must be kept scrupulously clean, every facility must be afforded for free drainage, the wound must be frequently irrigated, and when the neck has been opened the patient should be fed through a tube for some days after the operation.

The head should be fixed after the manner adopted in treating cases of laryngeal cancer.

CHAPTER VII.

OPERATIONS ON THE ŒSOPHAGUS.

ŒSOPHAGOTOMY.

Anatomical Points.—The gullet commences opposite the cricoid cartilage, and on a level with the sixth cervical vertebra.

The average diameter of its lumen is 20 mm. (the width of a sixpenny piece); at the cricoid cartilage the width is only 14 mm. The œsophagus in the neck follows the curve of the cervical spine, and also curves a little laterally (to the left), the sweep of the curve extending from the cricoid to the root of the neck. It is in close relation in the neck with the trachea, the thyroid body, the carotid arteries (especially the left), the inferior thyroid artery, the middle thyroid veins, and the recurrent laryngeal nerves.

The operation of œsophagotomy is carried out, as a rule, for the removal of foreign bodies which have become impacted in the tube. In one or two instances attempts have been made to dilate a simple stricture of the gullet through an incision in the neck.

Instruments required.—Gag; tongue forceps; œsophageal bougie and forceps; scalpels; blunt-pointed bistoury; retractors; sharp hook; artery and pressure forceps; dissecting forceps; long-bladed, toothed dissecting forceps; scissors; needles; needle-holder; periosteal elevator to assist in removing the foreign body.

The Operation.—The general features of the operation are similar to those which attend a ligature of the common carotid. (*See* page 131, vol. i.) The gullet is approached from the *left* side of the neck, inasmuch as the tube inclines to that

side. Should the foreign body be felt more distinctly upon the right side, then the incision may be made in that quarter.

The shoulders are well raised, the head is a little extended and is turned to the right or opposite side.

Every attempt should have been made to define the exact position of the foreign body before the incision is begun. A skiagram of the neck showing the foreign body is indispensable. The situation of the cut will be influenced by the locality of the foreign body. Very usually it is the commencement of the œsophagus that is exposed.

The skin incision will commence opposite to the upper border of the thyroid cartilage, and will be continued downwards along the anterior border of the sterno-mastoid muscle for about three inches.

The first steps of the operation are identical with those for ligaturing the common carotid. (*See* page 131, vol. i.)

As soon as the skin and fascia have been divided, the finger should be introduced into the wound, and the position of the impacted substance be further defined.

The omo-hyoid muscle is drawn downwards, and must be divided if necessary. The sterno-hyoid and sterno-thyroid muscles must be drawn a little aside, and, in cases where the foreign body is low down, may need to undergo some division of their fibres.

The sterno-mastoid and the large vessels are drawn outwards. The carotid sheath is not disturbed.

The trachea and larynx are drawn over, or rather tilted over, to the inner or opposite side.

The position of the gullet can now be readily made out.

It may be desirable at this stage to pass a bougie or a pair of œsophageal forceps, in order to accurately demonstrate the situation of the tube and of the impacted body. It must be remembered that the œsophagus, when empty, is flat and tape-like, and does not exist as the well-rounded tube which figures in most anatomical text-books.

The inferior thyroid artery and the superior and middle thyroid veins must be carefully avoided. The last-named vessels will usually need to be ligatured and divided.

All bleeding having been arrested, the gullet is steadied by a pair of fine, long-bladed, toothed forceps, and is opened longitudinally over the site of the foreign body.

The recurrent laryngeal nerve runs in the groove between the œsophagus and the trachea. The gullet must be opened through its lateral wall, so as to avoid injury to this nerve. In the actual operation it will appear that the œsophagus is being opened as far back as possible.

The opening in the tube must not be extended by tearing, or be dilated with dressing-forceps; it must be cautiously enlarged by a blunt-pointed bistoury.

The removal of the foreign body must be carried out with the greatest care, and a curved periosteal elevator will be found a most valuable instrument in freeing the substance and prising it into the wound.

When the body is of irregular shape, and has been long impacted, very great difficulty may be experienced in removing it. I was occupied in one case for more than twenty minutes in extracting from the gullet a hard-metal plate of teeth, which had been impacted for eleven months.

By the introduction of forceps through the wound, foreign bodies have been extracted from the thoracic segment of the œsophagus.

If the wound in the gullet be a clean cut, if the case be recent, and the foreign body have been impacted for but a short space of time, then the œsophageal incision should be closed; and this more especially applies to the cases of children and young subjects. The sutures employed should be of very fine catgut, and they can be most conveniently introduced by means of a curved needle, held in a Hagedorn's holder.

If, however, the body has been long impacted and the gullet is much ulcerated, or if the wound in the gullet has been lacerated, and has been exposed to much bruising, then the use of deep sutures had better be dispensed with. The skin-wound in such case may be narrowed above and below by a few suture points, but the median and main part of the wound must be left open. A good-sized drainage-tube should be passed to the bottom of the wound. In no case is it well to

entirely close the superficial wound, even in instances where the incision in the œsophagus has been united. The wound in the gullet may yield, or may be torn open by violent vomiting, and the food-matters and mucus which find their way into the tissues of the neck should be permitted the very freest means of escape.

If in a case where the gullet wound has been closed no sign of extravasation occur for seven days or so after the operation, then the superficial wound may safely be closed.

An open wound is the great safeguard after œsophagotomy.

Even when the wound has been long open, and when food and mucus have escaped from the neck, and when much unhealthy suppuration has been induced, the parts at the end close well, and the resulting cicatrix is often wonderfully neat.

The wound is dusted with iodoform, and is dressed with light gauze, sal-alembroth or other wool, or with sponge.

After-treatment.—The after-treatment of these cases involves considerable care, and often not a few difficulties.

The patient should lie in bed, with the head and shoulders well raised.

The neck must be fixed and made rigid, and this can be effected by means of one of the simpler forms of apparatus employed in cases of cervical caries. It is essential that the part be kept at rest, and unless the head be fixed it will be found that the region of the wound is very frequently disturbed, especially when the patient is fed.

The longer the patient can be kept, immediately after the operation, without food *per os*, the better. The strength must be maintained by nutrient enemata. Thirst may be relieved by rectal injections of warm water.

The patient may be fed by a tube on the second or third day. The tube should be soft, and should be passed by the mouth. This method of feeding must be repeated until the parts are sound.

If the wound in the gullet has been closed, and has remained closed, the tube may be given up in seven or ten days. If the

wound be left open, or if it reopen after it has been closed, the tube should be employed until the wound in the neck is granulating well and has been reduced to small dimensions, and until it is evident that the cut in the gullet has healed.

When the aperture in the œsophagus remains free there is a great disposition for the cervical wound to become very foul, in spite of ordinary attention. The mouth should be frequently rinsed out with a carbolic solution, and the wound, which should be dressed very lightly with gauze, should be irrigated with some antiseptic solution many times a day. When the patient is fed with the tube a little food is very apt to escape into the mouth, and also out of the wound. Both mouth and wound should, therefore, be well washed out after each act of feeding.

It is when milk is extensively employed that the parts tend to become most foul.

Iodoform forms a very suitable material for dusting upon the wound.

The chief cause of death in these cases is septicæmia, consequent upon the foul condition of the wound. Other elements in the mortality are cellulitis, pneumonia, and exhaustion.

ŒSOPHAGOSTOMY AND ŒSOPHAGECTOMY.

The former of these operations has been proposed as a substitute for gastrostomy in cases of cancer of the gullet. It is assumed that the stricture is high up, that the tube can be opened below it, and that the patient can be fed through the artificial opening thus established. The objections to this operation are, however, so numerous and so pertinent that it has not been adopted, and it cannot be considered to belong to the domain of practical surgery.

Œsophagectomy, or excision of portions of the gullet (for malignant disease), was first suggested by Billroth, and first carried out successfully by Czerny in 1877. Czerny's patient died of recurrence of the disease about a year after the

operation. An account of the procedure is to be found in *Beiträge zur operativen Chirurgie*, s. 48, 1878. Mr. Butlin ("The Operative Surgery of Malignant Disease," 1887) has collected six examples of oesophagectomy. With the exception of Czerny's case, these operations may all be classed as unsuccessful.

As Mr. Butlin points out, the operation has at present obtained no *locus standi*, and there is very little probability of its becoming a useful or even a justifiable method of treatment.

Part IX.

OPERATIONS UPON THE ABDOMEN.

CHAPTER I.

ABDOMINAL SECTION.

THE term abdominal section is applied to the opening of the abdominal cavity either for purposes of exploration or with the object of operating upon the abdominal or pelvic viscera.

Abdominal section implies the opening of the cavity of the belly at any point on the parietes, although in the great majority of instances the incision is made in the median line. As an operation *per se* it has no very distinct individuality. It is obvious that little in the way of definite treatment can be accomplished by the mere opening of the peritoneal cavity. It is remarkable, however, what unexpected effects have followed from a simple exploratory cut into the abdomen. By such a cut many mysterious disorders have been cured, many neuroses have ceased to be, and hypochondriacs have been relieved of their troubles. More than that, substantial sarcomatous growths have undergone temporary diminution. In cases of tuberculous peritonitis the simple incision of the abdominal wall has a definite curative effect, which cannot at present be explained. The section is employed for purposes of exploration and diagnosis, and in order that the fingers may be introduced so as to assist in certain extraperitoneal operations. Owing to the very fortunate want of special names, however, the term abdominal section includes the incision made for the evacuation of pus within the peritoneal cavity, for the relief of peritonitis by irrigation and drainage, for the reduction of certain internal herniæ, and the liberation of snared or adherent bowel, for the unfolding of volvulus, for

the reduction of intussusception, and for other purposes of like character. The majority of abdominal operations have special names, such as ovariectomy, gastrectomy, cholecystectomy, etc. It is important, however, to bear in mind that in all these procedures the major operation is the abdominal section. Abdominal surgery—in the sense in which the term is at present used—became possible as soon as it was shown by what means the peritoneal cavity could be opened with comparative safety, and the ordinary measures of surgical treatment applied to diseased conditions within its walls. The removal of a small ovarian tumour in an uncomplicated case is—as a surgical operation—a procedure of a comparatively trifling nature. The gravity of the case is represented by the fact that the excision must take place within the abdominal cavity. In the earlier periods of abdominal section the great shadow which haunted the operator was peritonitis, which at one time appeared to be almost inevitable, and which led to death after death.

It is well that it should be borne in mind that there is nothing especial in this particular branch of surgery, and that no exceptional principles are involved in the details of the many operations which it includes.

Abdominal surgery represents merely the application of the common principles of operative surgery to the treatment of parts within the cavity of the belly.

The progress of this branch of the surgeon's art has been impeded in its development by attempts to conduct operations within the abdomen upon principles which could not have found acceptance in the surgical treatment of allied conditions in other parts of the body.

The treatment of purulent peritonitis by incision and drainage involves no other than the ancient practice observed in the treatment of other retained inflammatory effusions. The removal of a pedunculated tumour by ligaturing the pedicle and cutting away the growth beyond the ligature is an illustration of one of the oldest principles in surgery. That such a mode of treatment could be safely applied to a tumour within the abdomen was a surgical revelation.

The art of removing a stone from the kidney is based upon the same elements which direct the surgeon's hand in dealing with a stone in the bladder. That the kidney could be freely cut into was the remarkable new thing.

What is phenomenal in the development of abdominal surgery is the adaptation of a few common principles of treatment to parts with very varied anatomical features, to tissues of quite peculiar structures, and to organs of whose behaviour under direct surgical treatment nothing was known.

It would be out of place to attempt to deal here with the history of this splendid branch of modern surgery. The facts and dates are known, but a critical history of this remarkable period in the development of medicine has yet to be written.

Without wishing to detract in the least from the distinguished part which McDowell, Nathan Smith, Atlee, Charles Clay, and other pioneers have taken in the development of abdominal surgery, it may be safe to assume that in the future the history of this brilliant development will be associated mainly with the names of Sir Spencer Wells and Lord Lister. Spencer Wells developed the technical features, the method, the handiworkman's part. Ovariectomy, as a definite, well-founded surgical measure, grew under his hand. Among the numerous company who have devoted themselves especially to abdominal operations he stands forth, and always will stand forth, as the master surgeon. The work of Lister rendered it possible that the common principles of operative surgery might be applied to the regions within the abdomen. It was he who explained the mystery of wound healing, the meaning of putrefaction in surgery, the lines of safety and the sources of danger in the treatment of operation wounds.

Lister's work rendered abdominal surgery in its modern aspect a possibility, and it is under his ægis that this marvellous branch of the operator's art has advanced.

Anatomical Points.—The skin over the anterior abdominal parietes is movable, the subcutaneous tissue is lax, and the amount of fat in that tissue is often considerable. The surgeon can soon learn from experience to form a fairly correct idea of the thickness of the integuments in the specific case under notice, and the length of the incision will have to be regulated to a certain extent by the depth of the soft parts. It is impossible to give any data as to the thickness of the anterior abdominal muscles should the opening be made away from the

middle line. The abdominal muscles of an athletic man and those of a bedridden old woman can hardly be compared—they are different things. In all subjects some of the thickest muscle will be found above and to the inner side of the anterior superior spine, from which and the adjacent crest and Poupart's ligament radiate bands of the internal oblique and transversalis. Transverse division of muscle in doing abdominal section should

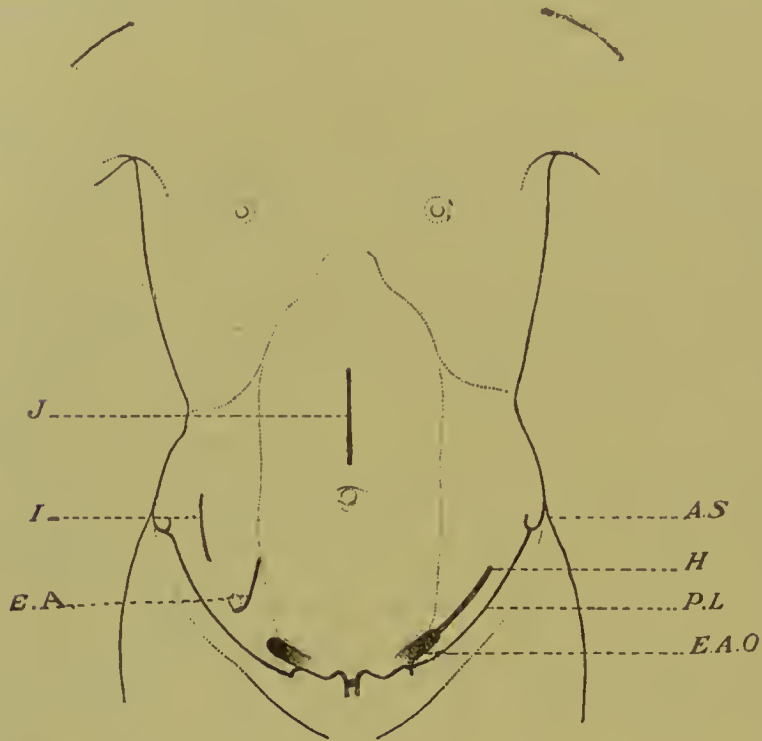


Fig. 344.—LINES OF INCISION EMPLOYED IN VARIOUS ABDOMINAL OPERATIONS.

E.A., position of deep epigastric artery and the internal abdominal ring; E.A.O., external abdominal opening; H, incision for radical cure of inguinal hernia; I, incision for removal of vermiform appendix; J, incision for tuberculous peritonitis, exploration of upper part of abdomen, etc.; P.L., Poupart's ligament; A.S., anterior superior spine.

be avoided as far as possible, since it is apt to leave a weak scar. In the most common abdominal operations—median section, radical cure of hernia, etc., no muscle fibres need be divided as a rule. The beginner should remember that in most patients the abdominal muscles are thinner than text-books and anatomical plates would lead one to suppose.

There is no *linca alba* below the umbilicus, and it is scarcely possible, except in instances where the parietes have been much stretched, to avoid exposing one or both of the margins

of the recti muscles. The precise construction of the rectus sheath, especially of that part that lies below the umbilicus, should be borne in mind. The pyramidalis muscle, when large, may entirely cover the median line, and section of the fleshy fibres cannot in such case be avoided. The muscle very seldom extends beyond the lower third of the interval between the pubes and the umbilicus.

The linea semilunaris may be represented by a slightly curved line drawn from about the tip of the ninth costal cartilage to the pubic spine. In the adult it would be placed about three inches from the navel. The outline of the rectus can be well seen when the muscle is in action. It presents three "*lineæ transversæ*," one usually opposite the xiphoid cartilage, one opposite the umbilicus, and a third between the two. The two upper of these lines are the best marked.

The site of the umbilicus varies with the obesity of the individual and the laxity of the abdomen. It is normally situated from three-quarters of an inch to one inch above a line drawn between the highest points of the two iliac crests.

The only arteries of any magnitude in the abdominal walls are the two epigastric arteries, some branches of the deep circumflex iliac (especially its ascending division), the epigastric branch of the internal mammary, and the abdominal divisions of the lumbar arteries. All these run in the deep muscular planes or the subperitoneal tissue, and the surgeon should bear their position in mind during certain operations. (*See Fig. 344.*)

1. The deep epigastric artery comes off from the external iliac midway between the anterior superior spine and the symphysis. It runs in the subperitoneal tissue obliquely upwards for two inches to the outer border of the rectus, and enters the muscle on its posterior surface. It is of interest alike in connection with excision of the vermiform appendix, ligation of the external iliac artery, and radical cure of inguinal hernia. We have known of one case of the latter operation in which accidental division of the deep epigastric caused such alarming hæmorrhage

as to necessitate ligature of the external iliac (the patient fortunately recovered).

2. The deep circumflex artery lies so close to Poupart's ligament and the iliac crest that it is never in the way of the surgeon, but behind the anterior superior spine it often sends upwards a large ascending branch, which runs between the transversalis and internal oblique. This may be divided in exposing the ureter, etc.
3. One or more of the lumbar arteries, passing behind the quadratus lumborum and so forwards between the abdominal muscles, may be divided in the various operations on the kidney. In opening a psoas abscess from behind it is particularly important to avoid wounding a lumbar artery close to its origin from the aorta, as the hæmorrhage would be serious and difficult to control. To avoid them the knife is entered on the level of and close to one of the transverse processes, the arteries lying between them.
4. The superior epigastric, like the inferior or deep one, runs behind or in the substance of the rectus muscle. It may possibly be divided during an operation on the gall bladder (right side) or during gastrostomy (left side).
5. The superficial epigastric and superficial external pudic vessels are of more interest to the surgeon than their size would indicate. During the radical cure of inguinal hernia and the high operation for varicocele one or other is always divided, and unless secured by ligature they may cause troublesome recurrent hæmorrhage. Of this we have known instances. Although all the superficial vessels are small, Verneuil has reported a case of fatal hæmorrhage from division of the superficial epigastric vessel.

Both the superficial and the deep epigastric arteries follow a line drawn from about the middle of Poupart's ligament to the umbilicus.

The following landmarks may here be noted. The aorta bifurcates about the level of the highest point of the iliac crest, and is therefore about three-quarters of an inch below and to the left of the navel. The cœliac axis comes off some four or five inches above the umbilicus. The superior mesenteric and suprarenal arteries are just below the axis. The renal vessels arise about half an inch below the superior mesenteric, opposite a spot some three and a half inches above the umbilicus, while the inferior mesenteric artery comes off from the aorta about one inch above the umbilicus.

It may be pointed out that in the female the respiration is more thoracic than abdominal. The converse holds good for the male, in whom the anterior abdominal parietes are consequently less steady. In the larger number, however, of cases for which abdominal section is performed the anterior belly wall is practically motionless.

Preparation of the Patient.—Very many directions—some of them not a little remarkable and ridiculous—have been given under this head. The subject of abdominal section needs but the preparation that should precede any great surgical operation. (*See* page 22, vol. i.) There is very little that is especial to note. In not a few cases time for preparation is not forthcoming. If the patient be a female, the operation may be conveniently performed shortly after the complete cessation of a menstrual period. It is important in every case that the condition of the kidneys should be investigated, and before operations on the kidney or bladder it is well that for a week before the operation the urine should be examined every day, and a note made of the precise amount passed in the twenty-four hours.

An aperient should be given over night, and be followed by an enema early on the morning of the operation. When convenient and possible, the patient should have a hot bath on the evening that precedes the operation. The question of shaving off the pubic hair may be left until the patient is under the anæsthetic. The details of the patient's dress have been already dealt with (page 25, vol. i.), as well as the preparation of the room in which the operation is to be performed (page 35, vol. i.).

Instruments required.—Two stout scalpels, with a cutting edge of $1\frac{1}{2}$ to 2 inches in length. Dissecting forceps (2 pairs). Straight probe-pointed bistoury. Pressure forceps (10 or more pairs). Large pressure forceps (2 or 3 pairs). Medium-sized pressure forceps. Artery forceps. Hagedorn's needles for the parietal sutures. Needle-holders. Small needles (curved and straight). Two large blunt hooks. Scissors (straight and curved on the flat). Catgut and silk in various sizes. Silkworm gut. Sponges. Sponge-holders.



Fig. 345.—SPENCER WELLS'S
LARGE COMPRESSION FOR-
CEPS (CURVED BLADES)

To these may be added—dishes for instruments, maeintosh sheets, the dressings and binder, an electric lamp or an ordinary lamp. and hand mirror.

The pressure forceps.—The small pressure forceps are of the ordinary pattern (page 45, vol. i.). The large pressure forceps—designed by Sir Spencer Wells—are constructed upon the same lines, but are of much larger size. They measure about ten inches in length, the blades occupying about two and a half inches. Some are straight; others have the blades bent at an angle to the shanks (Fig. 345).

They are extremely useful for seizing and holding a tumour or cyst wall, for grasping an extensive mass of adhesions, or for clamping omentum. They form, moreover, safe and convenient sponge-holders (page 227). Medium-sized pressure forceps, with blades about one inch and a half in length, are occasionally useful.

The blunt hooks are used for the purpose of steadying the edges of the abdominal wound while the sutures are being applied (page 66, vol. i.).

The hook should be as thick as a No. 6 catheter, should have a perfectly blunt point, and should form the curve of half a circle with a diameter of not less than one

inch. The hook and its handle are made of one piece of metal.

Drainage-tubes are now very seldom required in abdominal surgery. When a purulent collection is opened up, the ordinary rubber drainage-tubes, supplemented or not by drains made of gauze, are the most useful. In non-suppurative cases drainage when required—and it is very rarely needed—is best carried out by means of lengths of sterilised gauze.

The best *sponges* for abdominal operations are the Gamgee tissue sponges described on page 55, vol. i. Three or four of these sponges will suffice for a simple abdominal section such as an exploratory incision or the removal of a non-adherent vermiform appendix. In extensive operations two or even three dozen sponges may be needed. For many years past I have used these simple substitutes for the natural sponges in every abdominal operation I have undertaken. It is well in operations of magnitude to have six special sponges of Gamgee tissue prepared and put in a separate dish, with the understanding that they and they alone are inserted within the abdomen should it be necessary to introduce a sponge. These special sponges are “quilted,” so that no particle can be accidentally left behind, and to each one a long thread is attached, the end of which remains outside the wound. If these sponges are formally counted before and after the operation, and if under no circumstances are any other sponges introduced into the abdomen, the risk of leaving a sponge behind is reduced to a minimum. Should ordinary sponges be employed, they should be selected with care. Supposing that twenty are employed, ten should be ordinary rounded sponges of medium size. Six should be small sponges, to be used with the sponge-holders, and the remaining four should be flat, two of them large and two small. All should be of the finest Turkish sponge, and it is desirable that the flat sponges should be of very close texture.

Sponge forceps made upon the type of the largest pressure forceps, but much lighter, form the best sponge-holders for abdominal operations. They hold the sponge evenly and very firmly, and enable the surgeon to retain perfect control over the sponge when it is traversing the depths of the peritoneal cavity.

Antiseptic solutions, etc.—The instruments, after removal from the steriliser, should be placed in sterilised water at the temperature of 100° F. If ordinary sponges be used, they should be rinsed in warm sterilised water which is frequently changed. Should the abdominal cavity or any part of it need to be washed out, sterilised water at the temperature of 100° F. is employed.

Position of the Patient.—The operation table should be of the usual height, and should be narrow. The patient should lie as near as possible to the right-hand side of it. The patient's upper extremity should be supported, clear of the edge of the table, and with the elbow flexed. I employ an adjustable bag into which the elbow is dropped. Temporary loss of power in the limb is apt to follow the placing of the hand behind the head or behind the back. In some cases this paresis has lasted for months. The lower extremities are neatly enveloped in a small blanket, and around that a thin macintosh is tightly wrapped with equal care. No blanket is left exposed, and the macintosh reaches well up the thighs. Its object is to keep the blanket dry. The flannel jacket worn by the patient covers the chest and upper limbs. Towels, taken direct from the steriliser and absolutely dry, should be arranged around the area of operation on all sides.

Before proceeding further the pubic hair should be shaved off. This is most essential in male subjects, in whom the hair often extends a considerable distance upwards along the median line. After the shaving, the surface is well rubbed with the alcoholic solution of biniodide of mercury.

The dry sterile towels are so applied over the trunk and lower limbs that only the area of the operation is exposed. No blanket is visible.

The surgeon's hands can only come in contact with the sterile towels; and should any instrument be laid down for a moment near to the wound, it will rest upon the same aseptic surface. The whole body, indeed, with the exception of the face, left hand, and part of the abdomen, is covered with hot, dry, sterile towels. Before the towels are finally settled in place, a large pad of cotton wool should be forced in between

the legs and wedged up against the perineum. This will serve to collect any fluid which may find its way under the protecting sheet, and save the delay of much cleaning after the operation has been completed.

The table should be so placed that its foot is in front of a window. The chloroformist stands at the head, the surgeon on the right-hand side, and the assistant on the left. A table for the basins, antiseptic solutions, etc., is placed to the left of the operation table, and here the two nurses are placed. A smaller table for the instruments stands close to the surgeon's right hand. Upon this table may also be kept a small bowl of warm sterile water, in which the surgeon can rinse his hand to remove blood clot, etc., from time to time during the operation.

Two nurses are required. Only one assistant is necessary for the operation. His duty is to sponge, to look after the forceps, to prevent intestine from protruding, to steady the wound edges while the stitches are being introduced, and to help in any other way.

THE OPERATION.

1. The Parietal Incision.—The surgeon steadies the abdomen with the left hand, the thumb being on one side of the intended wound and the fingers on the other, and makes a clean cut in the median line from two to three inches in length.

The incision is usually placed midway between the umbilicus and the pubes, and stops some two inches above the pubes. In fat subjects the incision will have to be a little longer. The knife should make a clean cut through the skin and subcutaneous tissues down to the aponeurosis. Bleeding is checked by pressure forceps, which are left *in situ*. The bleeding vessels must be neatly isolated and neatly picked up. A casual mass of subcutaneous fat must not be clutched up with the vessel between the blades of the forceps. The operator need not trouble about the sheath of the rectus. There is no linea alba below the umbilicus, and the knife need only follow the median line, avoiding the cutting of muscle as far as possible. Unless the

two recti are separated by distension, one or both of the rectus sheaths will as a rule be opened.

The transversalis fascia is now reached. It is possible to mistake it for the peritoneum, and the subperitoneal fat beyond for omentum. This fascia and the fat, if any, beneath should be divided by a clean cut of the knife. No director is required, nor should one be used. It is about this stage of the operation that some surgeons enlarge the area of the wound with the fingers, tearing up the fascia in a meaningless manner. All such handling of the wound is useless, and distinctly to be avoided. The advice that the peritoneum should be exposed by tearing is not sound.

It is important to clearly recognise the peritoneum. It is best identified by noting the tissues that have been cut through. The "blue colour," the "glistening surface," and the "arborescent vessels" belong to the department of fiction.

When adhesions exist, the peritoneum may not be demonstrable as a coherent membrane.

Before any attempt is made to open the abdominal cavity all bleeding should have been checked. Any pressure forceps that are attached need not be removed at the present stage. The peritoneum should be pinched up as a very minute fold with a good pair of dissecting forceps. Normal peritoneum can be so picked up. Thickened and adherent peritoneum cannot be thus dealt with; nor can the wall of the bowel be quite so readily and minutely picked up should a piece of gut be exposed and its surface be mistaken for the lining membrane. The forceps that grasp the little fold of peritoneum should be moved to and fro and lifted up and down, to ascertain whether the membrane is free or not. The membrane is finally divided by cutting upon or close to the point of the forceps, while they are being drawn away or lifted up. No hook or other unusual instrument is required to pick up the peritoneum, but toothed forceps are often useful.

When adhesions exist, there is difficulty in ascertaining when the abdominal cavity has been really reached, and there is nothing to guide the operator but his surgical and anatomical intelligence. Any doubtful layer of tissue should be picked up

and gently rolled between the finger and thumb. Its character can in this way be at once estimated, and the existence of deeper attachments demonstrated. The operator who has the fear of adhesions before his eyes, and who has not noted the layers of tissues as they have been cut, may readily separate and strip off the undivided peritoneum with his fingers, under the impression that he is dealing with adhesions within the abdominal cavity. This is especially apt to occur when a large smooth tumour is pressed against the parietes.

The peritoneum should be divided by a clean even cut. It may conveniently be divided by seissors if preferred. I have seen the membrane rent open with the fingers—a practice that has nothing to commend it.

As soon as the abdomen is opened, the divided peritoneum on either side of the centre of the wound is seized with pressure forceps. These forceps remain in place until the operation is completed. They act as retractors; they keep the peritoneum in position, and they render the introduction of the finger or of a sponge very easy. They also serve as a guide to the introduction of the sutures. Before they are dispensed with the little margin of peritoneum which they have hold of should be cut away with the forceps, since this tissue is likely to be damaged by long compression. When the forceps are in position, two fingers can be introduced for purposes of exploration.

If the incision has to be enlarged, it is effected with a straight probe-pointed bistoury, the two fingers being used as a grooved director. If the wound be extended downwards, the position of the bladder must be defined before the knife is used.

If the hand has to be introduced, the incision must of necessity be increased. There is often a disposition not to make the wound large enough. More harm may be done by rough efforts to drag a solid growth through a small incision than by a liberal extension of the incision in the median line.

In certain cases, as soon as the wound has been completed, a large sponge may be at once introduced into the pelvis. It is retained there during the operation, and by absorbing any blood that finds its way into Douglas's pouch saves sponging at a later stage. The intestines must be prevented from

protruding either by the introduction of a flat artificial sponge or by the fingers of an assistant. One of those present should be entrusted with the responsibility of taking count of all sponges introduced into the abdomen.

It has been claimed that in ovariectomy, and other forms of abdominal section in which the surgeon works chiefly in the lower part of the abdomen, there is a decided advantage in placing the patient in Trendelenburg's position—*i.e.* with the pelvis raised and the abdomen sloping downwards towards the thorax. It is urged that by this means not only are the intestines kept out of the way, but the tendency to venous congestion is diminished and hæmorrhage is more easily controlled. For my own part, I have found the Trendelenburg position of no advantage except, perhaps, in the ligaturing of the iliac vessels. After a careful trial, I have entirely abandoned this position of the patient. If a cyst ruptures in process of removal, the contents flow towards the diaphragm, and, if such contents be septic, inconvenience may follow.

The omentum often gives much trouble, especially the fine thin omentum of young children, by clinging to the fingers and to sponges, and by becoming entangled in instruments. It may be necessary to keep it out of the way by means of a long narrow sponge attached to slender forceps.

2. Treatment of Adhesions.—Adhesions must be dealt with according to common surgical principles. The lighter, more recent, and more slender can be broken down by the finger or by a sponge.

The firmer must be clamped, divided, and tied—either with catgut or fine silk. Extensive strands of adhesions should be clamped in sections, cut, and the bleeding points picked up individually with artery forceps, and tied in the usual way.

In no circumstances is the use of the actual cautery to be commended for the arrest of bleeding from divided adhesions.

Oozing from a level surface can very usually be checked by continued pressure with a sponge. If the oozing be more persistent, and if no individual vessels can be isolated and tied, the bleeding surface when small may often be “sequestered” or sewn over. A Lembert's suture is made to traverse the peri-

toneum on either side of the bleeding area, and when the suture is drawn tight the bleeding surface is covered over. When the area is large a fine needle, carrying silk, is made to pass beneath the bleeding surface, and when this buried suture is drawn tight the surface is constricted and turned in. This may be called "sewing in" as compared with "sewing over," when peritoneum is employed. Great care should be taken in dealing with deep pelvic adhesions. They can be exposed by the use of ivory spatulæ, and in demonstrating their character and attachments reflected light from a mirror or the electric lamp is very useful.

Adhesions to the bowel and to the bladder must be gently dealt with. When slender, they can be readily stripped off by means of a sponge. When dense and extensive, it is better to clamp the adhesion, to cut it through at some little distance from the viscus, and to ligature it *in situ*. In separating adhesions from bowel, it is easy to tear away the serous coat and to expose or even tear the muscular coat. Such false membranes are probably nourished from the viscus to which they are attached, and I have seen no harm to follow from leaving quite considerable masses of such tissue attached to intestine. In cases where a portion of cyst wall is firmly attached to the bowel, it is very undesirable to make persistent attempts to separate the two. It is far better to cut away the cyst, leaving the adherent portion still attached to the bowel. Such attached portion may be reduced to the smallest dimensions, by dissecting off as many laminæ as possible, and be allowed to remain as a permanent appendage to the gut. In many cases I have left a considerable portion of the cyst wall still attached to the bowel.

It should be borne in mind that, in endeavouring to free the intestine of firm adhesions, it is very much more easy to tear the bowel than to tear the false membrane.

Moreover, such attempted separations, even when they do not tear the gut, are apt to strip off a great deal of its peritoneal coat. The muscular coat beneath is probably atrophied from disuse, the result of the adhesion, and a perforation of such damaged intestine is quite possible. Extensively adherent

intestine will be found to have very attenuated walls, and to be most readily torn.

Adherent omentum can be dealt with in considerable sections. The adhesions may be peeled off with the finger. Portions, of the thickness of the forefinger, may be included in one ligature. It is more satisfactory, however, in dealing with omentum, to ligature the individual vessels with silk whenever practicable. The method adopted must depend upon the vascularity of the tissue. In some cases, where much traction has been exercised upon the epiploon, its cut surface will scarcely bleed at all. On the other hand, when an ovarian cyst, with a twisted pedicle, is obtaining its chief or sole blood supply from omental adhesions, the vascularity of the tissue is often considerable.

Adhesions may in some cases be so dense, so close, and so extensive that they have to be divided by the scalpel by extensive incisions. It must be borne in mind, however, that such adhesions have sometimes but a slight vascularity, and that they can be often divided without remarkable bleeding. Indeed, I have observed that the hæmorrhage from a surface exposed by such division is usually not so considerable as that from the area exposed by tearing down soft recent adhesions with the finger. Still, these dense attachments must always be regarded with the greatest respect.

In many instances when an organ, such as a cyst or a diseased vermiform appendix, is so very adherent as to be described as buried or lost in adhesions, it is well to ignore at first the actual adhesions and to divide the peritoneum at some little distance from the adherent organ, so as to open the subserous tissue. The finger is introduced into this lax tissue, and the separation of the organ is carried out subperitoneally, the adhesions being divided upon the finger (introduced beneath them) as soon as they are well isolated.

Whenever practicable, it is desirable that a very adherent structure should be first of all approached by the subperitoneal route. When no inflammatory adhesions exist, but when the tumour or cyst has, in enlarging, made its way beneath the peritoneum so as to become more or less entirely hidden, then

the separation of the mass should always be effected by dividing the peritoneum around it, and by enucleating it through the medium of the subperitoneal tissue. In such a proceeding care must be taken to note the position of the normal blood vessels of the part concerned. These are secured as they are met with.

3. Toilet of the Peritoneum in Septic Cases.—The thorough cleansing of the peritoneal cavity, well termed by Worms "*la toilette du p ritoine*," is a matter of primary importance in certain abdominal sections.

In an abdominal operation in which no septic material is encountered—and the majority of abdominal sections are of this type—the peritoneum needs very little if any attention. The serous membrane is very well able to look after itself, and the more one sees of abdominal operations, the more one is impressed with the marvellous powers of the peritoneum in this direction.

Its power of protecting itself, of dealing with sterile effusions (such as blood or the fluid of some cysts), and of rapid healing is only weakened and damaged by surgical interference. Extensive sponging out of the peritoneal cavity in non-septic cases is to be condemned, and flushing out of that cavity in such cases is absolutely unwarranted.

It is well that any effusion, such as blood or cyst fluid, should be removed, but that object is never to be persisted in at the cost of extensive sponging. I have many times left a not inconsiderable amount of sterile cyst fluid, and possibly of blood, in the peritoneal cavity without disadvantage, being convinced that that fluid would do less harm than the persistent and long-continued sponging needed to remove it completely. In connection with non-septic cases, the term "the toilette of the peritoncum" has done harm, as it has led to a perfectly unnecessary damage being inflicted upon a delicate membrane, which is well able to look after itself so long as it is uninjured. After any aseptic abdominal operation, all blood clot and cyst fluid should be removed as far as is possible and as completely as is possible, but never at the cost of long-continued and over elaborate sponging. It is a mistake to suppose that pure blood

in a non-septic abdominal cavity is a noxious thing. It is quite harmless in comparison with the over-fussy sponge.

In the cases to be considered in the present section, not only has much blood found its way into the pelvis and among the intestines, but a collection of pus has possibly discharged itself during the operation, or faecal matter has escaped through a perforation of the bowel, or the abdominal cavity has been flooded with the fluid from a septic cyst. In such instances no trouble must be spared until the peritoncum has been cleansed of the impurity.

As to the actual process. The sponge which was probably placed in the depths of the pelvis at the commencement of the operation should be removed, and then all the soiled districts of the peritoneum are very gently cleansed by sponges on holders or held in the hand. Such sponges will absorb the grosser part of the effusion.

It is especially, of course, in Douglas's pouch that fluid is apt to collect. Another district is the iliac fossa, and another part that particularly encourages the accumulation of fluid is the perirenal region. In extensive operations, where a large parietal wound has been made, these districts may be sponged out with comparative ease.

In cases where there has been an extensive extravasation of septic fluid, it will be necessary to wash out the peritoneal cavity. For this purpose it is best to use plain water which has been sterilised by boiling, and which is kept about the temperature of the blood (100° F.). Care should be taken that this temperature is not exceeded, and every operating theatre should be provided with apparatus for aseptic irrigation.

The assistant holds up the margins of the abdominal wound while the surgeon pours the water into the cavity from a wide-mouthed irrigator tube. If no proper irrigator is at hand, the fluid may be poured from a common jug. Many quarts may be required. The fluid should be poured in until it escapes clear. The surgeon can assist matters by introducing his hand, and very gently rinsing the parts as the fluid is poured in. This flushing with water at blood heat has also the advantage of assisting to check capillary hæmorrhage, and is perhaps

the only means whereby foul material can be washed out of deeply placed hollows—such as may be found among extensive old adhesions—or from among intestinal coils.

In cases where peritonitis exists, or where faecal matter has escaped into the abdominal cavity, or where the extravasation consists of glairy cyst fluid, or of pus, or where much colloid or semi-solid matter has escaped, thorough flushing out of the abdominal cavity with warm water is alone efficacious.

As soon as the fluid poured in comes out clear, what remains may be taken up with a sponge. The patient's shoulders should be raised, so that the fluid lying among the intestines and in the hollows of the loins may drain down into the pelvis. By this change of posture enough fluid to fill Douglas's pouch will often run down, although before moving the patient the abdominal cavity may have appeared to be practically dry.

Before preparing to close the wound any spot suspected of bleeding, or the site of any especial ligature or suture, may be inspected. If the tissue to be examined be deeply placed, it may be brought into view by means of two wide ivory spatulae, so introduced as to press the viscera aside.

4. Counting of Instruments.—On completing the intra-abdominal operation, great care should be taken to ensure that no sponge or instrument has been left in the depths of the cavity. The sponges and clamp forceps should be formally counted. The leaving of a sponge or instrument within the peritoneal cavity is a catastrophe which no surgeon would feel greatly disposed to make public, and yet Dr. Wilson (*Trans. of Amer. Gynæc. Soc.*, vol. ix.) has collected no less than twenty-one instances of this unfortunate accident.

5. Closure of the Abdominal Wound.—In sewing up the incision made through the abdominal wall, the surgeon should aim at leaving the parts so far as possible in their original condition, *i.e.* the peritoneal surface should be smooth, and the scar in the muscular and aponeurotic layers firm and unyielding. Thus the possible dangers of adhesions of intestine, omentum, etc., and of ventral hernia will be avoided. Further, if any buried sutures are employed they must be absolutely aseptic; otherwise they are apt to cause trouble-

some sinuses, which will only heal on the expulsion of the sutures.

In many parts of the abdomen, such as the *linea alba*, a good plan is to pass silkworm gut stitches through skin, aponeuroses, muscle, and peritoneum. These sutures are securely knotted, and should be left in a full fortnight. A more perfect peritoneal surface can, however, be obtained by first suturing the two cut edges of this layer (these edges are secured by the pressure forceps which were applied when the wound was made). A continuous and very fine catgut stitch, introduced on a curved needle, is the most convenient, the line of suture being finished off as shown on Fig. 359. This detail, which takes only a minute or two, is strongly recommended in the majority of cases; besides preventing adhesions of intestine, etc., in the future, it is a convenience during the rest of the suturing, as the peritoneal cavity is thus shut off. A series of silkworm gut sutures is then passed through the remaining layers.

When cutting through muscular planes, as in the usual incision for removing the appendix, it is unnecessary to make a wide transverse gap in either internal oblique or transversalis. It is even possible (by dissociating the muscle fibres) to avoid cutting any of them across; this, however, is carrying caution to extremes. Provided that the parts are not in a septic condition, a few sutures of kangaroo tendon should be employed to each layer in turn, the incision in the peritoneum having been first sewn up by the continuous catgut suture.

If the abdominal incision be extensive, a thin flat sponge of greater length than the parietal wound is placed upon the intestines under the opening. It is retained during the introduction of the sutures. It serves to protect the intestines, and to absorb such blood as oozes from the suture points before the sutures are tied. If the thread be too small and the parietes thick, the suture has a tendency to cut through the tissues. If it be too large, it acts as a species of seton. Large-sized threads of silkworm gut appear to be peculiarly well adapted for these wounds. They merely require care in tying (page 50, vol. i.), and a certain number should be tied in a double knot, so as to avoid the risk of giving way when the patient strains or vomits.

Straight needles, three inches in length, should be used. The needles must be passed through the whole thickness of the parietes, and it is especially important that they should include the peritoneum. They are most conveniently introduced in the following manner :—

A blunt hook is inserted into either extremity or angle of the incision, and by exercising traction upon the hooks in opposite directions (precisely in the median line) the edges of the wound are rendered straight and parallel to one another. The incision opening can be made, in fact, a mere chink. By the use of the hooks the most perfect adaptation of the edges of the wound is ensured (Fig. 36, vol. i.). If the abdomen be distended, the narrowing of the incision opening tends to prevent protrusion of the intestines. If the belly wall be flaccid, the hooks enable the assistant to make the skin tense, and at the same time to draw the part of the parietes about to be sutured away from the viscera, and thus render a wound of the latter less easy.

The sutures should be introduced close to the margin of the wound, and at intervals of half to three-quarters of an inch from one another.

No suture should be tied until all the threads have been introduced, and until it is seen by traction upon the threads that a perfect adjustment of the edges can be effected.

The sutures should be tied in order from above downwards, traction being maintained all the while upon the blunt hooks. Care should be taken that the suture, as it is being tied, does not pick up and include a shred of the omentum. The peritoneal surface of the wound should be carefully examined with the finger from time to time. Before the last two, or possibly three, sutures are tied, the flat sponge should be seized with a pair of large pressure forceps and carefully dragged out, the blunt hooks being relaxed the while. Omentum is more apt to be included in the last sutures tied than in any others. The hooks are not removed until all the deep sutures have been secured.

Superficial sutures may now be introduced at any spot along the wound where the skin still gapes between the deep

suture points. These are best introduced by a curved needle of medium size held in a suitable needle-holder. A curved needle such as Hagedorn's is best suited for the suturing of a small abdominal wound, such as that made in the removal of the vermiform appendix.

ACCIDENTS DURING THE OPERATION.

The special accidents which may occur during the operation almost entirely concern wounds and other injuries of viscera. Such accidents are scarcely possible in a simple laparotomy, and could only result from inexcusable carelessness.

Accidents connected with the Parietal Wound.—In not a few exceptional instances the intestine, and even the bladder, have been incised in making the parietal wound. The bowel may have become adherent to the parietal peritoneum, or be very closely pressed against it in cases where it is distended. Moreover, when enormous coils of dilated bowel are lying tightly wedged against the anterior parietes, it may be difficult to tell when the peritoneal cavity has been opened. In such a case the thinned bluish-coloured wall of a coil of distended bowel may be mistaken for the parietal peritoneum, and may be picked up with forceps and incised. This is a more excusable accident when the serous coat of the bowel has been dulled by commencing peritonitis.

When extensive and complicated adhesions exist between the intestines, and possibly also between them and the parietal peritoneum—as in some instances of chronic peritonitis—it is very easy to wound the bowel in attempting to demonstrate the peritoneal cavity.

The bladder has been wounded in making the parietal wound, even when the viscus had been carefully emptied by catheter before the operation. In such circumstances it has usually been found that adhesions have prevented it from contracting and from sinking into the pelvis. In all cases extreme care should be exercised when, for any reason, the incision in the abdominal parietes has been continued lower down towards the pubes than usual.

Sir Spencer Wells records a case in which he cut into a patent urachus, from which urine escaped. He closed the opening by one of the sutures used to close the incision in the abdominal wall, and no inconvenience followed.

Accidents connected with the Intra-abdominal Operation.—These include the accidental wounding of viscera with the knife or scissors, but the great majority occur in connection with the treatment of adhesions. It is in attempting to remove ovarian tumours embedded in extensive adhesions that the most numerous accidents have occurred. The anatomical outline and the aspect of a part may be greatly altered by serous adhesions, and a viscus so disguised may be wounded in dealing with the false membranes that cover it.

In attempting to break down adhesions, the intestine has been torn, and the same accident has happened to the bladder.

The rectum has been lacerated or divided during the separation of adhesions. The ureters have been cut accidentally, and have been included in ligatures attached to deep adhesions. "It is remarkable," writes Sir Spencer Wells, "that in cases of adhesions low down in the pelvis the ureters should escape injury so often as they do. I suspect that their condition has been overlooked in some post-mortem examinations, and it is probable that in some of the cases where suppression of urine has been a prominent symptom; one or both ureters may have been injured."

The liver has been lacerated during the separation of adhesions. In one of Sir Spencer Wells's cases some ounces of the lower edge and under-surface of both lobes of an enlarged liver were removed. The hæmorrhage was stopped by perchloride of iron. The patient recovered.

Treatment of Injuries to the Hollow Viscera.—Wounds of the intestine should be carefully cleaned, and at once closed by the Lembert or Czerny-Lembert suture, fine silk being used.

During the remainder of the operation care should be taken to protect the coil so treated from pressure or further injury.

In cases of more extensive damage—as where a portion of the gut has been torn away—the bowel should be resected, and the divided ends at once united by suture. Should this accident

occur during an operation that has been already of unusual duration, and should it seem unsafe to further prolong the operation in order to unite the bowel, the two ends of the intestine may be brought out together at the parietal wound and an artificial anus established. This can be closed by a subsequent resection procedure.

Wounds of the bladder must be adjusted by sutures in a double row—the first involving the mucous membrane only, the second the outer coats. After the operation a syphon catheter should be introduced, so that the bladder may be kept perfectly empty for four or five days. Twice a day the bladder should be gently washed out with a weak borie acid lotion.

Laceration of the gall bladder could not be safely treated by suture only. Either a biliary fistula should be established, or the entire gall bladder should be removed.

If one ureter has been accidentally divided, a careful attempt should be made to unite the two ends by suturing, to facilitate which the lower end should be split. Drainage in the loin should be provided. Suturing has been carried out with success in several cases. If it be impossible, two courses are open: First to ligature the ends (after which the kidney will atrophy); or, secondly, to bring the proximal end out in the loin, and so establish a urinary fistula. The latter course will render subsequent nephrectomy necessary.

Treatment of Injuries to the Solid Viscera.—The liver is the only solid organ that appears to have been injured during ovariectomy. Bleeding from a wound or laceration may be arrested by pressure with a sponge; and if that fails, by the application of sutures passed into the substance of the organ.

Lacerations of the spleen or of the kidney may be closed by fine sutures, followed by the uniting of the peritoneum over them.

DRESSING OF THE WOUND.

This will depend, of course, upon the individual practice of the operator. Every possible form of dressing has been

employed. For my own part, I adopt the following:—The wound and the skin around are well dried, and the parts then dusted with iodoform. Over this a dry dressing is applied, and then a widely extending layer of wool to exclude the air. This is kept firmly in place by a carefully adjusted binder.

The binder should be made of fine flannel. It should be “gored” in four places along its upper part, in order that it may fit closer to the waist (Fig. 346). This “fitting” of the binder is important in all cases, and especially in women and in patients from whom a tumour of great size has been removed.

That portion of the binder which should come in contact with the patient's back is lined with lint, which has been carefully sewn on.

The binder is tightly and evenly applied, and secured by two large safety-pins, each four inches in length.

The weak part of all dressings applied to laparotomy wounds is the lowest part. It is here that the dressing or bandage “rucks up,” and it is easy in this direction for the wound to become infected. To obviate this defect two narrow strips of flannel bandage are so applied around the thigh as to keep the binder in place and also in close contact with the skin.

Each strip is applied while the thigh is flexed, is pinned to the binder over the pubic region, is made to traverse the perineum, and is finally attached again to the binder over the region of the iliac crest (Fig. 346). When the thigh is brought down from the position of flexion, these strips of bandage are rendered tight, and the binder is perfectly fixed in place. A considerable barrier of cotton wool will intervene between the

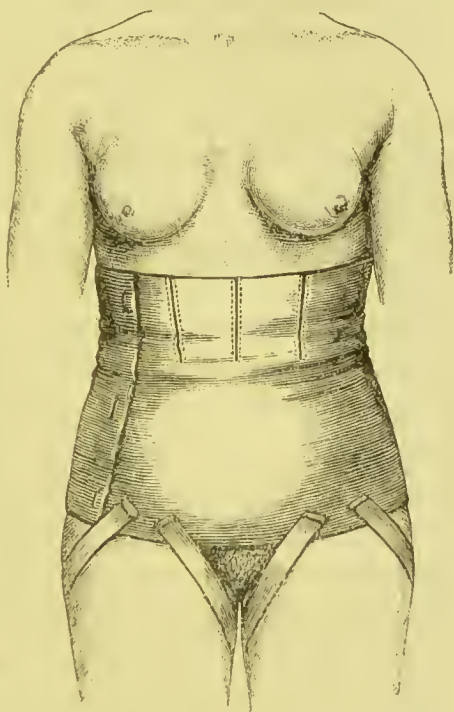


Fig. 346.—BINDER FOR USE AFTER ABDOMINAL SECTION.

lowest part of the wound and the lower edge of the binder ; and if the latter be well applied, it should be almost impossible to introduce the fingers beneath it.

AFTER-TREATMENT OF THE PATIENT.

General Measures.—The patient must lie absolutely upon the back, and the knees may be kept a little flexed by placing a pillow beneath them.

A large cradle is placed over the trunk. It protects the abdomen from the pressure of the bed-clothes, and helps to ventilate the bed. The patient's body is covered by a blanket, which is placed beneath the cradle and in direct contact with the trunk. The rest of the bed-clothes are in two sets, so folded as to meet transversely in the centre of the bed. They are placed over or outside the cradle, overlapping at its summit. This arrangement permits of the wound being inspected and dressed and enemata, etc., given without disturbing the bed-clothes that cover either the upper part of the body or the lower limbs.

The bed should be well warmed with hot bottles before the patient is placed in it, and hot bottles may be kept in contact with the feet and thorax for some time after the operation.

The patient's movements should be restrained while consciousness is returning, and the nurse may support the wound with the hands during the first attack of vomiting. The less the patient is interfered with during the first twenty-four hours after the operation the better. Morphia should be avoided whenever it is possible, and should never be given as a matter of routine. One-sixth of a grain is sufficient at a time. One injection only will probably be found to be sufficient.

The less taken by the mouth during the first twenty-four hours the better. Nothing whatever need be given by the mouth for the first nine hours. The patient is then allowed hot water or hot weak tea in doses of half an ounce every half-hour or so. Ice is to be absolutely condemned. The reckless and immoderate sucking and bolting of lumps of ice, which is encouraged by the nurse who believes a patient is doing badly

who is not constantly swallowing something, is most pernicious. The stomach becomes filled with cold fluid, and a sense of great faintness and discomfort persists until the melted ice is ejected by vomiting.

If really distressing thirst is experienced during the first twenty-four hours, it is best relieved by an enema of warm water. No other form of rectal injection should be allowed. During the second day the patient may take hot tea or barley water in small quantities, provided that such nourishment does not cause vomiting.

A catheter should be passed when required. It will not be needed during the first twenty-four hours, and the sooner the patient can discontinue its use the better. The practice of passing a catheter by routine once in so many hours is most decidedly to be condemned. As a rule very little urine enters the bladder during the first twenty-four hours after the operation. Nutrient enemata are not needed except in very unusual cases attended with persistent vomiting.

In a case that is doing well the diet from the third to the fourth day may consist of tea and toast, peptonised milk, malted foods, etc. Meat extracts and meat jellies of all kinds are to be avoided. Milk is not usually well borne, and leads to the formation of scybala, while the indiscreet perseverance in a slop diet often causes nausea and flatulence. What food is given should be given often and in small quantities. A little fish may be given on the fourth day, and meat on the seventh. Throughout the progress of an abdominal case patent foods are as much to be avoided as patent medicines.

The bowels may possibly act spontaneously. As a rule, however, they do not. In such circumstance an aperient followed by an enema should be administered on the third or fourth day.

The aperient selected should be that which the patient is accustomed to take. Castor-oil is much to be commended. The enema is most important for the purpose of clearing out the lower bowel. It may be repeated if there be any evidence that the rectum is not well emptied. The injection need not be copious; and in cases where extensive pelvic adhesions have been dealt with, even small enemata often cause distress.

Flatulence or distension of the belly is frequently complained of at an early period after the operation.

It may to some extent be relieved by the use of the "rectum tube." This consists in the vaginal pipe of an ordinary Higginson's syringe, or a large soft rubber catheter. The tube is passed about two or three inches into the rectum, and may be left there for ten or fifteen minutes, or so long as it appears to afford the patient relief. A small soap-dish must be placed under the free end of the tube, to receive any particles of fecal matter that may escape.

In these cases of flatulent distension minute doses of a carminative, notably of one of the aromatic oils, often have a very excellent effect, and the same may be said in a lesser degree of sal-volatile and spirits of chloroform. A hypodermic injection of strychnine ($\frac{1}{60}$ grain) is sometimes useful in overcoming intestinal distension. But probably the simplest and most efficacious measure is to turn the patient on the side for a time. This can often be done with safety, and affords relief to the backache so frequently complained of.

Now and then it will be found that about or before the seventh day after the operation—often about the fourth or fifth—the abdomen is distended, the tongue is coated and foul, the belly is tender, and complaint is made of the tightness of the binder, while there may be a little vomiting or nausea. The temperature remains normal, the respiration unaffected, the complexion unaltered, and the pulse and general condition good. The symptoms in such a case may depend upon the fact that the bowels had not been well evacuated before the operation, or the intestine may have been paralysed by too much opium, or the diet since the operation may have been such as to lead to tympanitic distension. The lavish use of meat extracts or concentrated meat preparations is very apt to be followed by great distension due to decomposition. The patient who presents these symptoms is often greatly relieved by a saline or other aperient. The bowel is well cleared out, and the sickness, the pain, and the distension vanish.

It is possible that cases of this character, relieved in the

manner indicated, may have been described as examples of acute peritonitis treated by saline aperients.

The graver complications after abdominal section—among which may be mentioned internal hæmorrhage, peritonitis, septicæmia, intestinal obstruction, fæcal fistula, thrombosis, parotitis, and pulmonary embolism—must be treated according to the measures advised in the treatises on surgery.

Thrombosis of the veins of the lower limb leading to phlegmasia is sometimes met with after abdominal section, but especially after ovariectomy. It is most apt to occur in patients who are allowed to stand or walk too soon. It should be treated in the usual manner.

Mr. Paget has collected no less than 101 cases of parotitis consequent upon disease or injury of the abdomen or pelvis.

The complication is rare after abdominal operations.

The trouble appears to be non-pyæmic, and very commonly ends in suppuration. It is possibly due to infection from the mouth along Steno's duct.

After-treatment of the Wound.—The dressing may be removed on the fourth day. The wound should be kept dry. It needs no washing, nor to be touched with anything moist. The dried iodoform powder is picked off with sterilised forceps, and fresh iodoform is applied under a new dry dressing. The value of an absolutely dry dressing is dealt with on pages 73-74, vol. i.

The binder and thigh pieces are once more adjusted.

The sutures should, as a rule, be left in for ten, twelve, or even fifteen days. In other words, a firm scar should have time to form before they are removed. The retention of the stitches will enable the operator to dispense with the subsequent use of strapping.

Throughout the whole period of convalescence the binder should be retained, and be always carefully applied.

In cases where the wound has become infected and fails to heal, or where it has burst open after the removal of the sutures by reason of violent expiratory movements on the part of the patient, or where the incision has been deliberately opened up by the surgeon, the margins should be kept well adjusted by

means of strapping, which in such cases will require to be re-applied once, or possibly twice, in the twenty-four hours.

For the first fortnight after the operation the patient should lie upon the back and be kept as still as possible. At the end of this time he or she may be allowed to be a little raised in bed, or to lie upon one side while the back is well supported with pillows.

Between the third and the fourth week the patient may be allowed to get up.

Such are the times which may be observed in an ordinary case of average severity. In a large proportion of instances it is well that the patient should remain in bed one month, whereas in the simplest exploratory operations the patient may be allowed up on the eighteenth day, or even before. Some surgeons will allow a woman convalescent from ovariectomy to leave the hospital on the eighteenth day. It is well, probably, to err in the direction of encouraging a longer period of rest after these operations. Some complications, notably that of phlegmasia, appear to be encouraged by too early movement.

In a few cases, before the patient leaves the surgeon's care, an abdominal belt should be ordered. This should be largely composed of elastic, and may be worn from three to six months. After the simplest procedures a flannel binder is all that is necessary; but in cases of pendulous abdomen, and in instances where the healing of the wound has been imperfect or interrupted, or a very large tumour has been removed, a well-made and very carefully-fitted belt is required.

The primary object of a belt in these cases is to assist the cicatrix in resisting the weight of the viscera and the passive pressure from within. It must be remembered that the abdominal wall is made up of muscular and aponeurotic tissues. It is required that these tissues should not be weakened. Like tissues elsewhere, they atrophy from disuse, and are rendered strong by exercise. The very elaborate, rigid, and heavy belts which are sometimes worn after abdominal section, especially after ovariectomy, may possibly do harm by taking upon themselves too much of the function of the muscles and aponeuroses.

CHAPTER II.

OVARIOTOMY.

History of the Operation.—Robert Houston, of Glasgow, treated an ovarian tumour by operation in 1701. The patient recovered, but the operation appears to have been represented merely by an incision into the cyst and the evacuation of its contents. The first complete and deliberate ovariectomy was carried out by Ephraim McDowell, of Kentucky, in 1809. The pedicle was secured by a ligature, the ends of which were brought out of the wound. The patient made an excellent recovery. In 1821 Nathan Smith, of Connecticut, who appears to have been ignorant of McDowell's work, performed a successful ovariectomy, in which he secured the pedicle with animal ligatures, which were cut short. The operation made great progress in America in the hands of Dunlap, Atlee, and others, and by the year 1850 at least thirty-six ovariectomies had been performed in that country, with twenty-one recoveries.

In Great Britain Lizars is reported as operating in 1824 and 1825, but his results were not encouraging. Granville operated in London in 1826 and 1827. In 1842 Charles Clay, of Manchester, commenced to perform ovariectomy. He carried out a large number of operations, and met with a fair degree of success. By the year 1850 ninety-one ovariectomies had been performed in Great Britain, with a mortality of 36·27 per cent. Spencer Wells performed his first complete ovariectomy in 1858, and Keith in 1862. For some years these surgeons were the two prominent figures in the development of ovariectomy, and it was under their hands mainly that the modern operation was evolved. Ovariectomy has now been shown to be one of the simplest and safest major operations in surgery, and there are very few surgeons who have not had a personal experience of this measure.

The history of the operation is associated to a large extent with an account of the different manner in which the ovarian

pedicle has been treated at different times. McDowell used a single ligature, and left the ends outside. Nathan Smith carried out the now accepted method of securing the pedicle with ligatures, which were cut short, and of dropping the stump into the abdomen.

Ovariectomy, the most frequently performed of abdominal operations, includes not only the procedure for the removal of ovarian tumours, but also of tumours of the parovarium, broad ligament, and Fallopian tubes.

Anatomical Points.—The following account of the surgical anatomy of the ovary, Fallopian tube, and broad ligament is taken from Doran's admirable work :—

Each *Fallopian tube* lies between the layers of the broad ligament, which are reflected over its upper surface and meet along its lower surface, when they are continued downwards towards the ovary. The serous membrane is held on to the tube by connective tissue, generally a little tenser and firmer than that which lies between the layers of the broad ligament lower down. Still, it is easily stripped off from the tube, whether by design or accident. The thin-walled cysts, so common in the folds of the broad ligament, are rare along this line of reflection over the tube ; and when they develop there they seldom, if ever, grow large.

The surgeon must not forget the fact that the ostium of the tube opens into the peritoneal cavity. Fortunately, inflammatory processes tend to close the ostium, and thus protect the peritoneum. If the tube be divided during an operation, care must be taken that the orifice on the proximal side is well closed. Each tube measures about four inches in length when not stretched artificially. It is seldom or never of the same length on the two sides. It becomes extended to an extreme degree in cases of simple broad ligament cysts which press against it.

The first inch from the fundus of the uterus outwards is straight and narrow ; this is known as the isthmus. The remainder is dilated, and is called the ampulla. This terminates externally in the conspicuous fimbriated extremity, which surrounds the ostium, or opening of the tube into the peritoneal cavity.

The canal of the tube is very narrow at the isthmus, barely admitting a bristle, and is narrowest at its junction with the uterine cavity. Along the ampulla the canal is wider.

There can be no doubt that the Fallopian tube is naturally patent. Vaginal injections (as Dr. Matthews Duncan has shown) may pass into the peritoneal cavity and set up peritonitis.

Of the fimbriæ one is much longer and thinner than the rest, and is known as the ovarian fimbria. It runs on to the tissues of the ovary. It is a good guide when the parts are altered by new growths—indeed, the fimbriæ altogether are excellent landmarks. Unfortunately, they are rapidly obliterated in inflammatory diseases of the tube itself, and this may cause great confusion to the operator. The ovarian fimbria is extremely elongated in cases of simple broad ligament cyst.

The outer part of the Fallopian tube turns downwards externally to the ovary, so that its fimbriæ embrace to a certain extent the outer part of that organ. The ovarian fimbria runs upwards towards the ovary—not downwards to the ovary, as usually represented. This relation of the tube to the ovary accounts for the singular shape of a dropsical tube, which curves outside and a little below the ovary, and also for the position of the foetal sac in cases of gestation in the outer part of the Fallopian tube, the sac lying not above the ovary, but outside, and often partly below it.

As the uterus always leans a little to one side, the ovary on that side hangs downwards more than its fellow, which is held almost horizontally between the ovarian and the infundibulo-pelvic ligaments.

The *ovary* is connected with the back of the broad ligament by its dense and tough hilum, which is invested by a plexus of veins, the bulb of the ovary. As the tissue of the hilum is continuous with the connective tissue between the folds of the broad ligament, morbid growths, developed in its substance, tend to burrow into these folds. The parenchyma, or ovum-bearing part of the ovary, hangs behind the broad ligament. It is connected with the uterus by a prolongation of the muscular tissue of the latter called the ovarian ligament, and invested by an elevation of the peritoneum.

This ligament is an important landmark when the surgeon is engaged in exploring the appendages during an operation; it is much stretched in cystic disease of the ovary, and generally hypertrophied in fibroid disease of the uterus.

The average weight of the normal ovary is at least 100

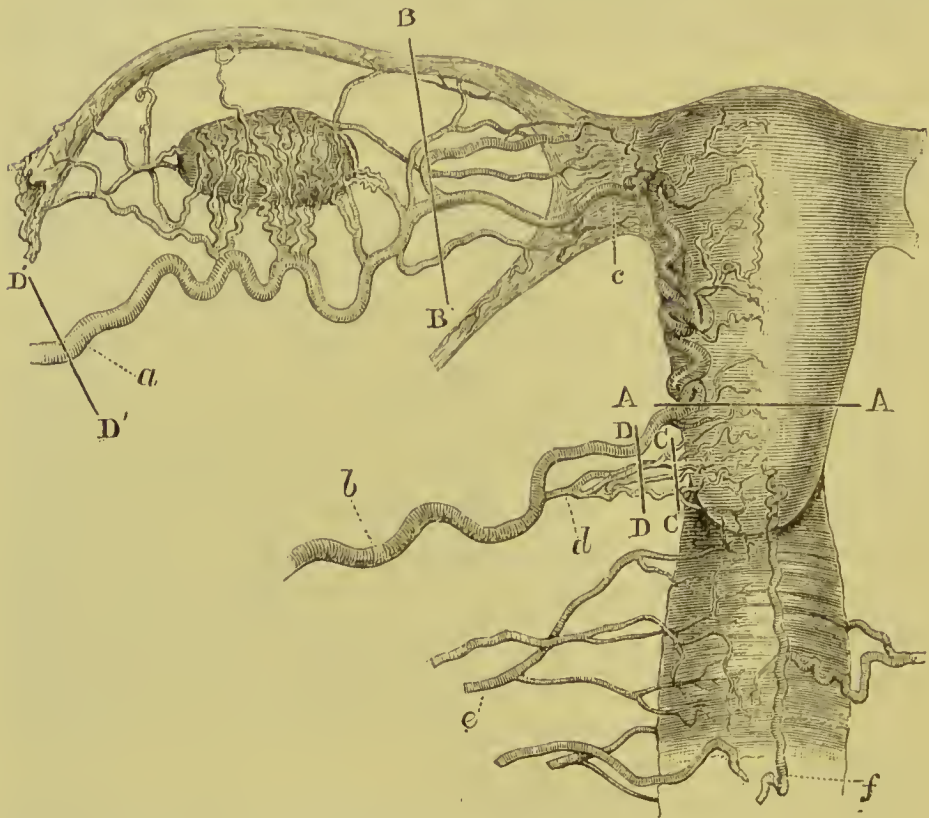


Fig. 347.—THE ARTERIES OF THE INTERNAL FEMALE ORGANS.

(Modified from Hyrtl.)

a, Ovarian artery; *b*, uterine artery; *c*, anastomosis of ovarian and uterine arteries; *d*, artery to the cervix; *e*, vaginal arteries; *f*, azygos artery of vagina; *A A*, Line of amputation in supravaginal hysterectomy; *B B* and *D D'*, vessels secured in hysterectomy; *B B* and *D' D'*, vessels secured in ovariectomy; *C C*, vessels divided in freeing the cervix.

grains. Its long axis is a little over two inches, its short axis one inch, its thickness quite half an inch.

The reflection over the fundus uteri extends along each Fallopian tube, and outwards and backwards over the ovarian vessels. The layers of peritoneum meet, after investing the tube, to form the *broad ligament*. The fold over the ovarian vessels is slight, yet well marked, and is known as the *infundibulo-pelvic ligament*. It appears as a short fold of peritoneum,

which runs from the brim of the pelvis to the ovary. It is described by Drs. Hart and Barbour as that part of the upper margin of the broad ligament unoccupied by the Fallopian tube. It is a structure of great importance, since it forms the outer border of the ovarian pedicle. It is easily recognised, on account of the pampiniform plexus of veins, which is conspicuous even in the normal condition. In ovarian cystic disease this ligament becomes hypertrophied, and appears as a conspicuous fold running from the brim of the pelvis on to the pedicle.

The layers of the broad ligament are closely applied between the tube and the ovary. Below the level of the ovary the layers separate, and pass to the sides of the pelvis. The pelvic connective tissue fills the space formed by the parting of the layers. This tissue can be felt as a tense band, running from the uterus to the side of the pelvis, on digital exploration of the vagina. When the rectum is explored, the back of the broad ligament can be reached. This is an impossibility in vaginal examination.

The layers of the broad ligament are often separated by tumours, which push in between them, either from the direction of the ovary or from the uterus, as in fibroid tumours. In the former case there will be difficulty in making a good pedicle; in the latter oöphorectomy may be dangerous, as the broad ligament no longer forms a sheet-like structure, but often becomes a pyramidal body, with its base towards the uterus, highly unsuited for the safe application of the ligature.

The ovarian artery (Fig. 347) enters the broad ligament from the pelvic brim, and becomes very tortuous when it reaches the infundibulo-pelvic ligament; and this tortuousness increases as it passes between the layers of the broad ligament, below the level of the ovary, upwards and inwards to the upper part of the body of the uterus. Before reaching the uterus it divides into two branches; the upper supplies the fundus, the lower anastomoses with the uterine artery, which passes vertically upwards to meet it. The branches of this artery are numerous. Several small vessels run to the dilated outer end of the Fallopian tube, supplying the fimbriæ. Half-a-dozen short, tortuous branches of wide calibre supply the ovary itself, entering that

organ through the hilum. Two or three branches run across the broad ligament to the inner two-thirds of the Fallopian tube, and the round ligament receives a special branch.

In ovariectomy and allied operations on the uterine appendages, the ovarian artery is divided in two places. It must be cut through at the outer border of the pedicle, where it lies in the infundibulo-pelvic ligament, and also at the point where it crosses the line of ligature of the pedicle—that is, in the middle of its course towards the uterus, between the layers of the broad ligament. Hence a complete segment of the artery is cut away, and may be easily detected on examining the tumour after operation.

The liberal supply of arteries to the broad ligament, and the shortness of secondary branches, account for the free hæmorrhage which occurs when the ligament is wounded or split in an operation on the internal organs, especially through faulty tying of the ligature. It is evident that the main trunk of the ovarian artery will bleed as much from its distal as from its proximal end, if not secured. The ligature applied to the outer border of the pedicle secures the ovarian artery as it lies in the infundibulo-pelvic ligament. The ligature which secures the inner half of the pedicle will, or should, hold firm the distal part of the ovarian artery, which communicates freely with the uterine. The division of the ovarian artery into two large branches, between the layers of the broad ligament, close to the uterus, is a source of peril when the pedicle of an ovarian tumour is very short.

The ovarian vein has the same general course as the ovarian artery. It forms near the ovary a plexus—the pampiniform plexus—which lies in the broad ligament, and communicates freely with the uterine veins. The ovarian artery can be felt, or even seen, pulsating amidst the turgid mass of veins. The plexus is surrounded by much loose connective tissue, which may inflame, and even suppurate if damaged by careless handling in abdominal operations. The bulb of the ovary is a venous plexus surrounding the hilum, and extending to the ovarian ligament. It communicates with the pampiniform and uterine

plexuses. It is very plainly seen in cases of oöphorectomy, when the ligature is tightened above a diseased ovary.

Preparation of the Patient.—This matter, together with the question of the position of the patient on the operation table, and the general disposition of the assistants, etc., has already been dealt with in the chapter on abdominal section (pages 225 and 228-9).

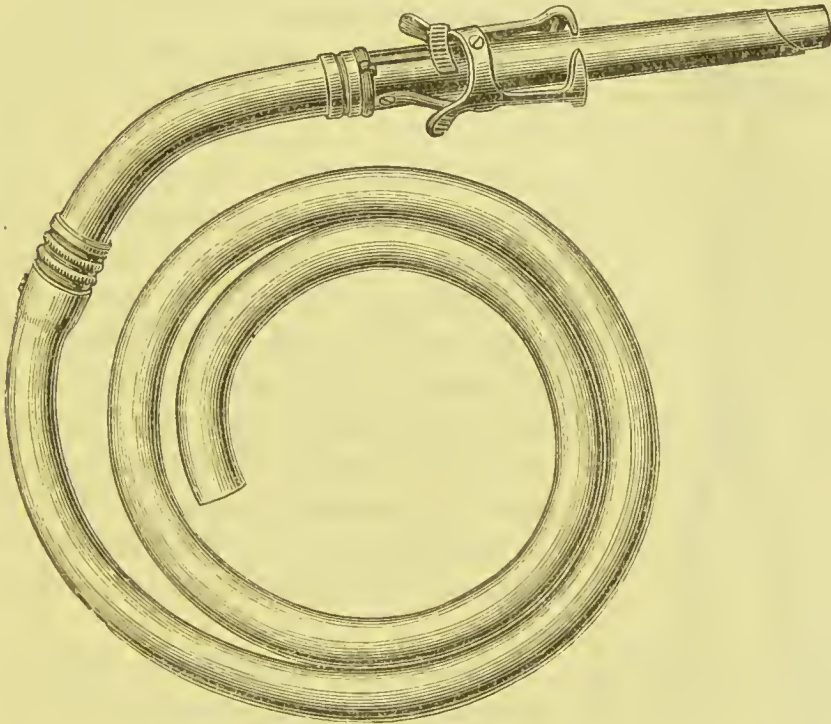


Fig. 348.—SPENCER WELLS'S OVARIOTOMY TROCAR.

Instruments required.—The following special instruments are required, in addition to those already enumerated as needed for the operation of abdominal section (page 226).

Ovariectomy trocar and cannula with tubing, Nélaton's volsella (two pairs), plain volsella, pedicle needle, simple trocar.

The ovariectomy trocar most generally used is that known as Sir Spencer Wells's syphon trocar (Fig. 348). The instrument is simple, and is admirably suited to its purpose. Its mechanism should be well understood before it is employed, and the surgeon should practise the movements necessary to withdraw and protrude the cannula. The spring hooks at the

side of the trocar are for the purpose of holding the margins of the hole in the cyst against the instrument. It should be borne in mind that these hooks have seldom so firm a hold as to allow unusual traction to be exercised upon the whole mass of the tumour. The gutta-percha tube at the end of the instrument should be not less than three feet in length.

Nélaton's Volsella is a powerful instrument, used for grasping and holding the cyst when required. It should measure about nine inches in length, and must be strongly made (Fig. 349).

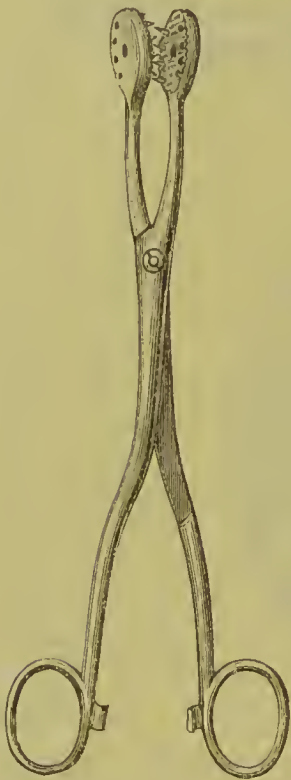


Fig. 349.—NÉLATON'S CYST FORCEPS.

Pedicle Needle.—A pedicle needle is now very seldom employed, and is not necessary. If one be used, that known as Sir Spencer Wells's blunt-ended needle is the best. The needle is fixed in a stout handle some four inches in length, while the shank is about six to eight inches long. The point is blunt, as are also the sides of the needle near the point. The eye is large and oval. The needle and its handle are best made of one piece of metal.

Two or three aneurysm needles of different sizes and curves should also be at hand.

Plain volsella forceps are occasionally useful in grasping the cyst wall, and also in picking up extensive bleeding points, as after the division of large adhesions, or the slipping of a ligature which has been applied to the same. A common trocar and cannula may be needed for the purpose of tapping secondary or deeply-placed cysts.

THE OPERATION.

1. **The Incision.**—The abdomen is opened after the manner already described. The incision should be of such a length as to enable the surgeon to extract the tumour with ease. About

three inches is the average length of the skin incision when first made. It may be commenced about three inches below the umbilicus.

2. Exposure and Examination of the Cyst.—The cyst is exposed, and is recognised by its white shining surface when free. Occasionally the peritoneum is found to be much thickened, or to be adherent to the cyst wall (page 258). In attempting to demonstrate the cyst under the latter condition, it should be remembered that to cut prematurely into the cyst is less serious than to strip the peritoneum from the parietes, under the impression that it is the wall of the cyst.

If any ascitic fluid be discovered, it should be allowed to escape, and should be pressed out of the flanks by the assistant. As soon as the peritoneal cavity is opened, a ruptured ovarian cyst may be discovered. The effused matter can be best got rid of by irrigation with warm sterilised water, at blood heat, and continuing the washing until the fluid flows out clear.

At the earliest possible opportunity the position and state of the uterus should be made out.

The possibility of pregnancy in cases of supposed ovarian disease should never be lost sight of.

It is possible also that the reputed ovarian tumour may be uterine.

“Uterine fibroids are of a pale brick-red colour, owing to the presence of plain muscular fibres and considerable vascularity. Sometimes the surface of a fibroid is very pale indeed, so as closely to resemble that of an ovarian cyst; and if the fibroid be cystic, there will be some difficulty in diagnosis at this stage. A fibroid bleeds violently, even if only slightly cut with the scalpel. In many ovarian or broad ligament tumours which have become invested anteriorly by a layer of the broad ligament, the surface also appears reddish in tint. The presence of the tube, stretched and elongated over the wall of the tumour, also indicates a tumour of this class, and may presage an easy operation, or else imply that some deeper complication exists; for tumours which burrow into the folds of the broad ligament often have very troublesome pelvic connections. The tube and broad ligament may happen to lie on the front of an ordinary

multilocular cyst; in this case the exposed surface appears like a veil of thin red membrane covering deeper structures, and very vascular. The tube, generally below, can be recognised. On pushing this membrane aside, the characteristic surface of the cyst wall will be exposed. When uncertainty exists about the tumour being of ovarian or uterine origin, further exploration will be necessary, even for bare diagnosis.

“When secondary cysts bulge freely from the surface, the chances are that the tumour is an ordinary multilocular cyst. When the cyst wall is smooth and shiny, but greenish-grey and semi-transparent, the tumour probably contains a great quantity of adenomatous growth. Malignant ovarian tumours are usually dull-brown or yellow-coloured; sometimes they may be recognised at once as solid masses of sarcoma; but when they contain large cysts, their diagnosis before tapping is often uncertain, the cyst which presents at the wound possibly bearing no malignant characters. A cyst with a whitish surface, rather dull and not very smooth, is probably an ovarian cyst with a twisted pedicle. A dull-white cystic tumour with orange or ochreous patches is very possibly dermoid” (Doran).

Ovarian cysts with twisted pedicle are, however, rarely white; purple or black is a much more usual colour. They may be on the verge of gangrene, and coated with lymph.

3. Demonstration of Adhesions.—Assuming the case to be a straightforward one of ovarian cyst, the tumour should be allowed to project into the wound.

The fingers or hand may be passed round the cyst to ascertain if any adhesions exist, and to estimate their character.

During such examination the lighter forms of adhesion may readily be broken down as the fingers pass gently over the surface of the growth. If firmer adhesions are found to exist, they must be fully demonstrated. Adhesions of all kinds are more readily to be dealt with before the tumour has been emptied by tapping. By attempting to break down adhesions after the cyst has been emptied, a portion of adherent bowel may be torn, the flaccid cyst wall and the bowel being difficult to distinguish from one another. “When a cyst is adherent,” writes Sir Spencer Wells, “it is often extremely difficult to

find out the exact limits or boundary between cyst and peritoneum; and rather than make any improper or dangerous separation, it is better to extend the incision upwards and downwards, until some point is reached where the cyst is not adherent."

4. **Tapping of the Cyst.**—Before actually introducing the trocar, a sponge may be inserted between the cyst wall and the lower angle of the incision, in order to absorb any fluid which may escape.

The cyst is steadied by the surgeon's left hand while the trocar is driven into its wall. In order to bring the walls well up to the hooks on the trocar, the plain volsella may be used; or the assistant may drag the cyst wall up within the grasp of the hooks as the tumour becomes more flaccid. The volsella is apt to make holes in the cyst, through which fluid may escape. Traction upon the cyst should never be made through the hooks on the trocar alone. These hooks are more for the purpose of holding the cyst wall against the cannula. "After the first cavity has been emptied, a second, a third, and more, if necessary, may be tapped successively, without removing the cannula from its hold, merely by pushing the trocar forward and thrusting it through the septum which separates the emptied from the adjacent full cavity. In this manner the whole tumour may be emptied of its fluid contents, and its bulk so reduced that it may be drawn through the abdominal opening without undue force.

"In a case where there are several cysts, which cannot be tapped one through the other, they must be emptied singly, either by the same trocar or by another." (Sir Spencer Wells). If the cyst be of moderate size or small it may be removed entire without tapping. This implies a larger abdominal incision, but the tumour remains firm and distinct, and readily handled. I am disposed to avoid tapping whenever feasible in dealing with any but large cysts.

5. **Removal of the Cyst.**—As soon as the part of the cyst that has been pierced by the trocar is well free of the abdominal cavity, the cyst wall may be grasped by two Nélaton's volsellæ, and traction upon the main body of the

tumour made by means of these instruments. At this time also the sponge introduced at the lower angle of the incision may be removed.

As the cyst is drawn outside the abdomen, the chief assistant follows it, as it were, from above.

By means of two large sponges—one held in each hand—he keeps the edges of the upper part of the wound together, exercises gentle pressure upon the escaping cyst, and prevents the protrusion of any coil of intestine or of the omentum. If the tumour be still of large size, any remaining secondary cysts may be tapped with a common trocar, or the supporting septa may be broken down with the fingers. When the secondary cysts are small and numerous, and the mass feels semi-solid, or when abundant glandular growths exist, the substance of the tumour may be broken up by the hand. To effect this the trocar puncture must be enlarged, and, the edges of the opening having been grasped by Nélaton's volsella, the hand can be introduced. Care must be taken that the forceps are so held that none of the broken-down contents can find their way into the abdominal cavity.

In manipulating the cyst, and especially when freeing it from adhesions, it is possible to tear the cyst wall and to allow the cyst contents to escape into the peritoneal cavity. The accident is not a serious one, as the fluid is nearly always quite sterile. If the rent be small, it may be closed by being grasped with large pressure forceps; if larger, an attempt should be made to bring the opening without the abdominal wound, and, by means of wedging sponges around the tear, to conduct the escaping fluid out of the belly.

In this way the injured cyst may be entirely emptied, and little of the fluid have found its way into the serous cavity.

In the case of more solid tumours the abdominal incision must be enlarged. It is much less serious to increase the size of the wound than to run the risk of rupturing the tumour by endeavouring to drag it through too small an opening. In these cases there is no virtue in a small incision. The escape of solid tumours is much assisted by judicious lateral pressure upon the abdomen, exercised by the hands of the assistants:

6. **Treatment of Adhesions.**—This matter has already been dealt with (page 232).

7. **Treatment of the Pedicle.**—The cyst having been drawn without the abdomen, nothing remains but to deal with the pedicle, which, in an uncomplicated case, now occupies the lower angle of the incision. In the majority of cases the pedicle is long, free, and tolerably broad. It is easily recognised by the Fallopian tube, which marks its upper or inner border.

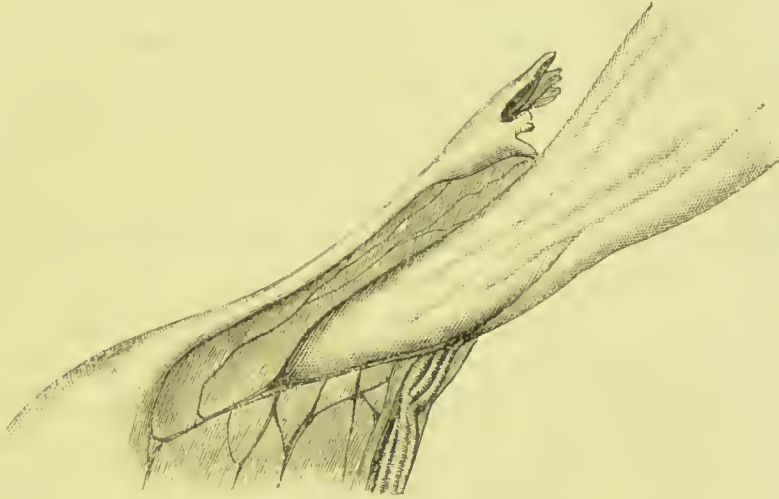


Fig. 350.—PEDICLE OF AN OVARIAN CYST.

The cyst has been tapped. The vessels in the outer border of the pedicle are indicated (semi-diagrammatic). (*Doran.*)

“The ordinary pedicle will consist of a plane surface, two or three inches wide, and about the same length, representing the tube, the broad ligament, the ovarian ligament, which may or may not be readily detected, and, lastly, an elevated ridge running from the back and outer part of the plane, upwards, outwards, and backwards, towards the lumbar region.

“This ridge, which forms the outer border of the pedicle, is filled with the large veins forming the pampiniform plexus and the ovarian artery” (*Doran.*) (*See Fig. 350.*)

The pedicle is secured by ligatures. The best material for the ligature is silk. Many surgeons use and strongly recommend kangaroo tendon. If silk be used it should be no thicker than is consistent with sufficient strength not to break in tying the knots.

In dealing with the pedicle, a rule should be observed which should apply to every abdominal operation—*a ligature should never be so applied as to include undivided peritoneum*. Exceptions to this important rule are very few, and are represented by such measures as the ligaturing of omentum and the securing of certain adhesions.

Before any ligature is applied, the peritoneum should be divided. The procedure is well illustrated by the treatment of the ovarian pedicle. The pedicle is as well displayed as is possible, and then with a small scalpel the serous membrane is divided completely on both sides of the pedicle in the line the ligature will follow. The subserous connective tissue in the pedicle is thus displayed, and gaps in the membrane are made evident, or are capable of being made evident. By enlarging these gaps the individual factors of the pedicle are isolated, the pedicle is reduced in bulk, and the separate parts are ligatured cleanly and precisely. A pedicle needle is not needed, as the ligatures are passed through the gaps made. I use three ligatures, one for the Fallopian tube, one for the ovarian ligament and tissues about it, and one for the pampiniform plexus and artery. These ligatures will not slip, whereas ligatures which embrace undivided peritoneum will often slip. The division of the peritoneum, moreover, undoubtedly saves much after-pain.

The knot tied should be a double reef or surgeon's knot, and the threads should be drawn as tightly as possible.

It is important, as the ligatures are tightened, that the assistant should relax his traction so that there is no tension of the pedicle.

The exact point at which the pedicle is transfixed must be determined by common surgical sense. The ligatures should not be placed quite close to the uterus on the one hand, nor too near the cyst on the other.

The threads must be cut short, and the pedicle divided with scissors three-quarters of an inch beyond the line of the ligatures.

Before the stump of the pedicle is dropped back into the pelvis, forceps may be attached to either margin of it, so that

at any time before the completion of the operation the divided surface may be drawn up for inspection.

There is nothing to commend the practice of clamping the pedicle before the ligatures are applied.

In examples of very broad pedicle the tissues may have to be ligatured in more than three sections.

A great deal has been written about the securing of the pedicle by ligature, and especially about the danger of splitting the pedicle. This accident is supposed to happen when the pedicle is secured by transfixion with the pedicle needle. I have never met with this trouble, and do not consider it possible if ordinary care is exercised.

In certain advised methods of securing the pedicle much ligature silk is employed, and is left *in situ*. This would appear to be undesirable. Probably the greatest safety is secured by the smallest, simplest, and neatest knot, and by the least possible disturbance of the ligatured area.

Abnormal Pedicles.--(1) The pedicle may be found to be short and broad, and the base of the tumour to be close to the side of the uterus. In such case there is no great difficulty in ultimately obtaining a practicable pedicle.

The peritoneum on all sides of the pedicle must be divided, and the component parts made evident. The vessels thus well isolated are secured, and then the tube and any remaining tissue.

(2) In other cases the pedicle is obscured by pelvic adhesions. These must be secured and divided one by one, or area by area, until a pedicle can be demonstrated. Mr. Doran points out that an atrophied second pedicle, in cases where the tumour consists of two cystic ovaries fused together, may be taken for an adhesion. When the pelvic adhesions are very short, broad, and tough, and a practicable pedicle exists, it is better to secure the pedicle first and deal with the adhesions later. In all instances a free division of peritoneum will be of great assistance.

(3) The pedicle may have been twisted, and consequently reduced to a mere cord almost devoid of blood-vessels, the cyst deriving its blood supply from adhesions, mostly from adherent omentum. This is very exceptional. In the more usual cases of recently twisted pedicle the ovarian tumour should be rotated

in the opposite direction of the twist until the latter is done away with. The pedicle is then displayed and ligatured in the manner already described.

(4) There may be no pedicle at all. In such a case the original pedicle has been twisted, has atrophied and disappeared the tumour receiving its sole blood supply through adhesions, such adhesions being very commonly with the omentum, as already stated. These adhesions are isolated and ligatured in strands or segments. (*See also page 265.*)

8. Completion of the Operation.—All bleeding having been arrested, the opposite ovary may be reached by passing the fingers along the uterus, and may be drawn up and examined.

The pelvis is now well sponged out. The stump of the pedicle should be drawn up by means of the forceps still attached to it, and, it having been examined, the instruments may be removed. Sponges should be counted, and the greatest care taken that no sponge or instrument has been left within the abdominal cavity.

No drainage will be required. Nothing now remains but to close the abdominal wound after the method described in the previous chapter.

9. The After-treatment has already been detailed. The period for recovery in an ordinary case may be reckoned at one month. Some surgeons allow their patients to get up at an earlier period than that named in the section on after-treatment (page 248). As a rule, a longer confinement to bed is usually advisable.

TREATMENT OF ENCAPSULED OVARIAN CYSTS.

Encapsuled Ovarian Cyst.—On exposing or on tapping an ovarian cyst, it may be found that the cyst wall is invested in front by a capsule, generally of a very pale red colour, and contrasting strongly with the white cyst wall behind it. The capsule is formed by the distended layers of the broad ligament into which the tumour has forced itself, and by peritoneum detached from adjacent parts of the pelvis. In extreme cases the inferior part of the cyst may lie below its serous capsule,

touching the pelvic fascia, and in close proximity to large vessels, the ureters, and the adjacent viscera.

In such case the capsule should be divided, and the cyst shelled out of its bed in the subserous connective tissue. The ovarian vessels should be laid bare as they approach the pelvic brim, and should be well exposed and, when isolated, ligatured. The tube is in like manner isolated and ligatured before division. The ovarian vessels may be spread over the cyst, but they will be found to come together at the pelvic brim. Never ligature large and vague masses of tissue. Divide the peritoneum, isolate the structures exposed, and cleanly ligature all those which need division.

The gap left in the capsule by the removal of the cyst may be closed by a few fine sutures. No drainage of any kind is needed.

RESULTS OF OVARIOTOMY.

The mortality of ovariectomy has been steadily reduced year by year since the operation was first introduced.

At the early periods of its development the death-rate was very high—so high that the procedure was condemned as unjustifiable by many. Up to 1876 Sir Spencer Wells had performed ovariectomy seven hundred and thirty-seven times, with a mortality on the whole series of about 26 per cent.

Sir Spencer Wells's analysis of one thousand cases of ovariectomy, published in the *Med.-Chir. Trans.* for 1881, is a contribution of great interest and of historical value.

The mortality is now represented by 2 to 3 per cent., or even less.

The conditions which influence the mortality of the operation are the same as those which affect the death-rate after other operations.

The special complication of *pregnancy*, however, requires notice. Ovariectomy has been performed with perfect success during all periods of pregnancy up to at least the seventh month.

In one instance (Pippingsköld) the operation was carried out at the commencement of labour, the patient recovering.

In some cases the patient has reached the full term, and has been delivered without complication of a living child. In other instances abortion has followed the operation at periods varying from a few hours to several days. Abortion directly due to ovariectomy has, according to Olshausen, occurred in less than 20 per cent. of all the recorded cases.

The same authority states that the operation has been performed during pregnancy in thirty-six cases, with only one death.

CHAPTER III.

REMOVAL OF THE UTERINE APPENDAGES.

THIS operation, which is also known by the name of oöphorectomy, has been carried out under the following varied conditions:—

1. To remove diseased uterine appendages. Under this heading are included chronic and subacute inflammation of the ovary, abscess of the ovary, displacement of that body, Fallopian pregnancy, and the various inflammatory and other affections of the Fallopian tubes.

2. To induce a premature menopause, in order to check hæmorrhage from the uterus, such as may be associated with uterine myoma. Oöphorectomy with this object has very properly fallen into disuse.

3. To check the progress of mammary cancer, especially when it has recurred after excision of the breast in too extensive a form to justify further attempts at removal. This operation is still in the position of a purely speculative measure.

The removal of the uterine appendages in cases where the structures are anatomically normal, or practically so, is an exceedingly simple procedure.

When, however, the appendages are diseased, the surgeon who proposes to remove them embarks upon an enterprise the precise course and ending of which he cannot foretell. Some of these operations are difficult and complicated, and present a very uncertain and intricate series of conditions.

In not a few cases it has been found to be impossible to complete the intended excision.

When very large myomata exist, the procedure is complicated by the size and position of the tumour.

Every case must be considered upon its merits, and the surgeon must have clear notions as to the amount he intends to remove in various circumstances. In the majority of instances the parts excised will be represented by the ovary, the parovarium, the outer three-fourths of the Fallopian tube, together with the corresponding part of the ovarian artery, the pampiniform plexus, and the broad ligament.

The operation will be described as it would be carried out in a case in which the parts are practically normal. The treatment of the various complications which arise when the parts are not normal will be considered subsequently.

Instruments Required.—The same as for ovariectomy with the exception of the trocar, the volsella, and the cyst forceps.

The Operation.—The patient having been prepared for abdominal section, a vertical incision about two inches in length is made over the linea alba below the umbilicus. The centre of the cut will be nearer to the symphysis than to the umbilicus.

The cavity of the peritoneum is opened in the manner already described. The intestines and great omentum will be largely prevented from getting in the operator's way if the patient has been placed in Trendelenburg's position—*i.e.* with the pelvis raised above the level of the thorax (*see, however, page 232*).

All bleeding having been checked, two fingers are introduced into the wound, and the fundus uteri is sought for. The fingers embrace the broad ligament as if they were the blades of very long dressing-forceps, and are carried outwards—one on each side of the tube—until they are arrested by the ovary.

The ovary is now drawn out of the abdomen by the two fingers, which retain the same forceps-blade attitude. It is then handed over to an assistant, who holds it well away from the abdominal wall. The surgeon displays the pedicle, carefully and completely divides the peritoneum with a fine knife, and ligatures the structures exposed in the manner already described (*page 261*). Three silk ligatures are employed, one for the tube, one for the vessels, and one for the ovarian ligaments and remaining structures.

It often happens, even when no adhesions exist, that there

is some difficulty in dragging the ovary well out of the wound. This is notably so when there is a thick layer of fat upon the abdominal parietes. In such cases much strain falls upon the broad ligament, and the surgeon's fingers alone are not sufficient to hold the parts in place. In these instances it is necessary that the appendages should be seized by large-elbowed pressure-forceps.

The pedicle in this operation is secured in precisely the same way as in ovariectomy (page 261). Silk of medium thickness is commonly used, but kangaroo tendon answers admirably.

The parts are cut away close to the retaining fingers or the retaining forceps, and at least a third of an inch from the ligature.

Before the division is made, it is well to fix one or possibly two pairs of artery forceps upon that part of the pedicle which lies between the ligature and the intended line of section. When the division is made, the forceps—which inflict no damage upon the part—prevent the stump from falling at once back into the pelvis, and allow it to be examined at leisure, and to be drawn forth should further ligature be needed.

The wound is closed, and is dressed in the usual way.

Throughout the operation the anæsthetic must be carefully administered. Should the abdominal muscles undergo sudden contraction (as from coughing) when the ovary is without the wound, and when the pedicle is about to be dealt with, the appendages may slip back into the abdomen again if lightly held, or be needlessly dragged upon if rigidly grasped.

Treatment of Adherent Appendages.—The omentum may be adherent to the appendages, and may at the same time also be attached to other parts of the surface of the peritoneum. As a result of these adhesions the anatomy of the part may be greatly confused, and a condition be induced which is at first peculiarly puzzling. In other instances the appendages may be bound down by adhesions, or be lost in a confused mass of cicatricial tissue. It may be impossible to identify the ovary by the touch. The surgeon may be quite unable to demonstrate any kind of pedicle. The structures to be removed may be adherent to the bowel, or to the bladder, or to the peritoneum lining the floor of the

pelvis. They may be the seat of abscess or of some variety of cystic formation, and the removal of the diseased parts without rupturing the abscess wall may be attended with the greatest difficulty.

Each case must be considered on its merits. Omental adhesions can be dealt with with comparative ease, but the adhesions which fix the appendages may defy the most patient and most skilful operator. Until the adhesions have been dealt with it will be impossible to bring the appendages into view or into such a position as will enable the operator to apply the necessary ligature.

In such cases the wound must be enlarged ; and by means of suitable retractors and a good light, aided by efficient sponging, the parts to be removed must be exposed, and the adhesions dealt with as the particular case requires. The Trendelenburg position and an electric hand-lamp will be found most useful.

There is little to commend the practice of attempting to effect the separation of the appendages with the fingers only, working through a small incision. Skilful fingers might effect much—and in few operations is a highly-educated touch of greater value—but there is nothing in this procedure to justify a direct departure from the sound principle that the surgeon should, whenever possible, be able to see what he is doing, and that manipulations in the dark are not worthy of encouragement. Of the two evils—a large incised wound in the median line of the abdomen, and the risk of tearing structures while breaking down adhesions which are hidden from view—the former is without doubt the lesser. In some of these cases the bleeding is described as being occasionally “truly alarming.” If there be a risk of “alarming” bleeding from wounds and lacerations in the depths of the pelvis, let the external wound be large enough to allow the surgeon to deal with that hæmorrhage in a straightforward manner.

The small incision in these cases involves a procedure which is unsafe and difficult, unsound and clumsy. It can appeal only to those who aim at a certain theatrical effect, and who test the greatness of an operator by the littleness of his incisions.

CHAPTER IV.

HYSTERECTOMY.

HYSTERECTOMY, or removal of the uterus, is carried out for myoma, for incurable inversion, and for malignant disease.

For uterine myoma (fibroid tumour) complete hysterectomy (by an abdominal incision) is now advocated. Occasionally the cervix uteri is left behind (supravaginal amputation), and in the case of small myomata vaginal hysterectomy is occasionally performed. For incurable inversion the removal may be partial or complete. In dealing with malignant disease the removal should be complete, and if an attempt is to be made to remove the lymphatic glands the abdominal route must be adopted of necessity. The immediate mortality of this operation is, however, considerably higher than that of vaginal hysterectomy. .

History of the Operation.—Granville, in 1827, is reported to have removed a uterine myoma, but without success. A few isolated instances of the operation are recorded in succeeding years, but none of the patients recovered. The first successful operations were performed by two American surgeons—Burnham in 1853, and Kimball in 1855. In 1861 Sir Spencer Wells performed his first hysterectomy for myoma. Mr. Keith's first case was in 1874. The development of the operation owes much to the successful and brilliant operations of Keith, who may be said to have first turned the tide in the direction of success. The literature of the subject is most voluminous. In Kelly's work on Operative Gynæcology will be found the best illustrated discussion of the subject.

The first successful vaginal hysterectomy for cancer is ascribed to Sauter, of Constance, who operated in 1822.

For many years the cases operated on were very few, and the mortality was very high. The operation was revived by Czerny in 1879, and was rapidly developed by Billroth, Sehroeder, Miekulicz, and others.

Freund carried out the abdominal method of operating in these cases, and his procedure was extensively imitated. The

results, however, were much more serious than those following vaginal hysterectomy. Even now, with much improved methods, abdominal hysterectomy for cancer is attended with greater risk than the vaginal operation, although it may be a more radical and efficient procedure.

Anatomical Points.—The peritoneum which covers the uterus is closely adherent to the fundus, but is less firmly attached to the lower part of the organ, where it is reflected to form the utero-vesical and utero-rectal pouches. The reflection of the peritoneum from the uterus to the bladder is about the level of the internal os. On the posterior part of the uterus the serous membrane descends for nearly an inch over the posterior vaginal wall before it is reflected on to the rectum.

The median utero-vesical pouch is separated from the para-vesical pouch on either side by two slightly marked folds, wherein are slight bands of unstriped muscle. Below these, and embedded in the subjacent veins, are the ureters. When the bladder is empty, and the uterus normal in position and size, a distance of nearly half an inch will separate the cervix from the point of entrance of the ureter into the bladder.

The lower third of the cervix projects into the cavity of the vagina; the middle third is connected with the base of the bladder in front, but projects behind into the vagina; the upper third is supravaginal, and is in direct relation with the bladder in front, but is covered by the peritoneum behind. The peritoneum can readily be detached from the posterior part of the vagina and cervix.

The ureter on entering the pelvis crosses the bifurcation of the common iliac arteries, and makes its way towards the cervix uteri. The uterine artery crosses it upon its inner side (*see* Fig. 351). The ureter will run parallel with the cervix, and at a distance of nearly half an inch from it, and will pass through the plexus of uterine veins, and beneath the broad ligament. Keeping close to the vagina, it enters the interval between the vagina and the bladder, and opens into the latter viscus about opposite to the middle of the anterior vaginal wall.

The ovarian artery and vein have been already described (pages 253-4). The uterine artery is, under normal conditions, no

larger than the posterior auricular, but in the conditions requiring hysterectomy it is usually several times as large. In its course forwards it keeps near to the floor of the pelvis, and reaches the uterus at its junction with the vagina. It gives branches to the vagina. It runs upwards on the side of the uterus, between the layers of the broad ligament, and follows an exceedingly tortuous course.

It is crossed by the ureter about the level of the external os. It supplies the uterus by many branches, and ends superiorly by joining with a branch of the ovarian artery (Fig. 347).

The uterine veins form an extensive plexus—the greater part of the blood from which is returned by the ovarian vein. The uterine lymphatics mainly end in a group of glands placed on either side along the internal iliac vessels and the bifurcation of the common iliac arteries. A few accompany the ovarian vessels to end in the lumbar glands surrounding the aorta.

The following operations will be described :—

1. Complete hysterectomy for myomata by the abdominal method.
2. Complete hysterectomy for cancer by the abdominal method.
3. Vaginal hysterectomy for cancer.

In the former edition the extraperitoneal treatment of the cervical stump was described in full. This method involved the use of a wire *serre-nœud*, and, although attended with some success, it has been generally abandoned. Supra-vaginal hysterectomy is still performed, and involves little risk of damaging the ureters, but the following objections to it have been urged.

There may be persistent oozing from the stump. The latter may become infected or may even slough. Owing to the extensive peritoneal seam, etc., intestinal adhesions and obstruction may develop.

On the other hand, if the cervix be removed, especial care has to be taken to avoid damaging the ureters.

1. COMPLETE HYSTERECTOMY FOR MYOMATA BY THE ABDOMINAL METHOD.

For fibroid tumours this operation is said to have been first performed by Bardenheuer. Dr. Christopher Martin, in 1896, reported six cases without a death; Dr. Herbert Spence (*Brit. Med. Journal*, October 11, 1902) records fourteen cases, all successful; Dr. Helme (*ibid.*) twenty-four, with only one death. Although the general mortality of the operation is probably larger than these very favourable statistics indicate, there can be little doubt that it is the method to be selected in dealing with fibroid tumours which are causing symptoms grave enough to justify operation.

Preparation of the Patient.—The bowels must be thoroughly cleared and the bladder empty when the patient is brought to the theatre. The pubes should have been shaved, and the skin disinfected in the usual way, the vagina washed out with a solution of lysol or bichloride of mercury.

Instruments.—These are very much the same as those required for ovariectomy. Long curved scissors, pedicle and various aneurysm needles, volsella forceps, and several clamp forceps (large Wells's pattern) will be required. For ligaturing the arteries and for the buried sutures most operators prefer sterilised silk, but care should be taken in its selection—*i.e.* it should be strong enough to stand any ordinary strain, but at the same time not needlessly thick. Catgut or kangaroo tendon may replace it to a large extent, but in tying the uterine arteries silk is the safest, as it is the least likely to slip.

The Operation.—Surgeons differ as to the most convenient position for the patient. Some strongly advocate the Trendelenburg posture. Others have the pelvis slightly elevated, and prefer this to the extreme inclination of the abdomen and thorax involved in the former position. Whichever be adopted, the operating-table must be placed so that a strong light falls on the wound, and, if practicable, a portable electric lamp should be at hand. The patient's limbs and chest must be kept enveloped in warm blankets throughout the opera-

tion; and, if the heart's action flags owing to hæmorrhage, immediate recourse must be had to injections of strychnia and transfusion of sterile saline solution.

(1) The abdomen is opened in the median line, and the tumour is exposed. Any adhesions encountered are dealt with. Provided that the case admit of it, the growth is delivered, is drawn out of the abdomen, and is lifted vertically upwards by one or more assistants.

Great care must be taken in separating adhesions of intestine or of the bladder. Those of the great omentum give little trouble, as multiple ligature of its vessels by means of an aneurysm needle will enable the adherent portion to be cut off and removed with the uterus. Any adherent portion of intestine must be carefully peeled off by blunt dissection; and it may be noted that a fatal result has sometimes followed an overlooked tear of the rectal wall. It is of the greatest assistance to deliver the fibroid uterus through the wound, and Kelly points out that when one rounded mass cannot be drawn up from the pelvis this may be attained by the assistant's fingers in the vagina pushing the tumour strongly upwards. At the same time the traction should not be sufficient to endanger the vessels in the pedicle. In raising the tumour a stout steel corkscrew will be found useful; it is fixed into the thickest part of the mass.

(2) The next step is to secure the arteries which supply the myoma. These vessels are two in number on either side—the ovarian, and the uterine. Their position can be ascertained without difficulty, and they are subject to very little anatomical variation. They are no larger than are the arteries which may have to be dealt with in removing very large tumours from the surface of the body, and the vessels can be reached before the trunks are breaking up into many branches.

The ovarian vessels are defined in the broad ligament, are secured between two sets of ligatures, and divided. The surgeon proceeds to sever the broad ligament—when that structure is still present as a ligament—in a direction which would correspond to a line roughly drawn from the brim of the pelvis to the cervix uteri. It is throughout divided by section of the

peritoneum. The veins of the pampiniform plexus are apt to be very voluminous, and may be as large as, or larger than, the thumb. The round ligament will need to be severed between ligatures. In due course the broad ligament upon either side will have been divided nearly to the uterus, and all the vessels belonging to the ovarian set will have been secured.

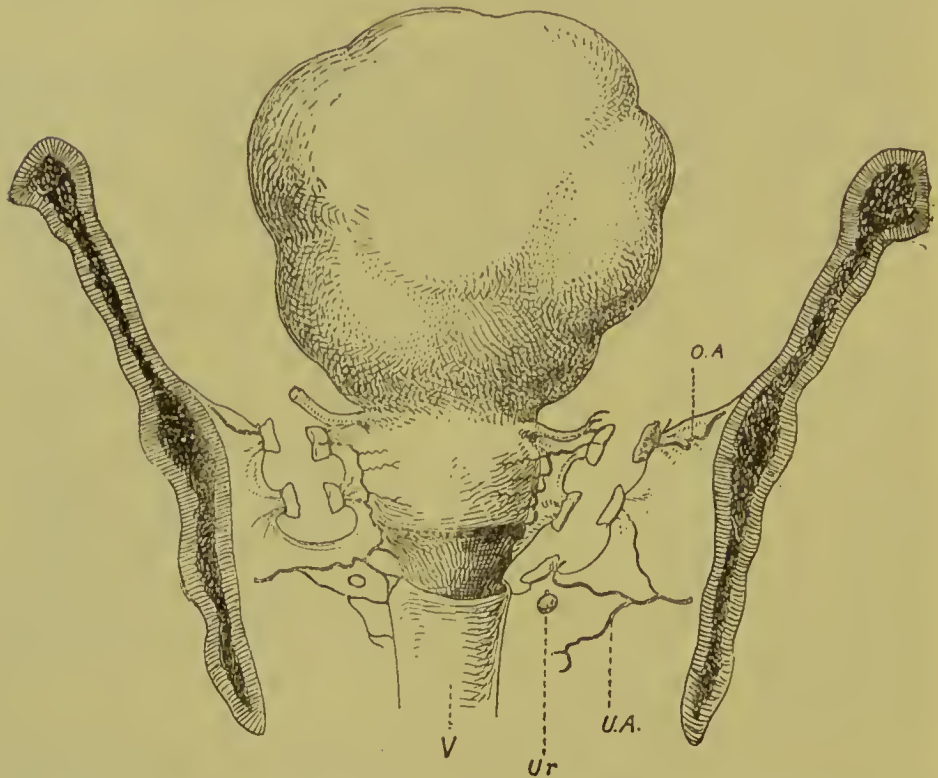


Fig. 351.—DIAGRAM OF COMPLETE HYSTERECTOMY FOR FIBROID TUMOUR. (From paper on Pan-Hysterectomy by Dr. Christopher Martin, of Birmingham.)

The figure illustrates the successive ligation of portions of the broad ligament and contained vessels. On the right side the uterine artery has been secured, on both the ovarian vessels.

V, Vagina; Ur, Ureter; U.A, Uterine Artery; O.A, Ovarian Artery.

Some operators advise that if the patient is under forty years of age the ovaries (with or without the Fallopian tubes) should be left. In other cases all the structures in the broad ligament and the appendages will be removed with the tumour. The former site of the ligament will be represented by a linear breach in the peritoneum along the floor of the pelvis, marked by many ligatures. The surgeon should endeavour in this part of the operation to render the broad ligament as flat as

is practicable, and to have the tumour so held that it is as little in the way as possible. The two round ligaments are divided, their distal ends being ligatured (on account of the vessels accompanying them), their proximal ends clamped or tied.

(3) Separation of the Bladder.—As the uterus is raised and drawn backwards the peritoneal reflexion from its wall to the bladder is carefully divided from side to side with scalpel

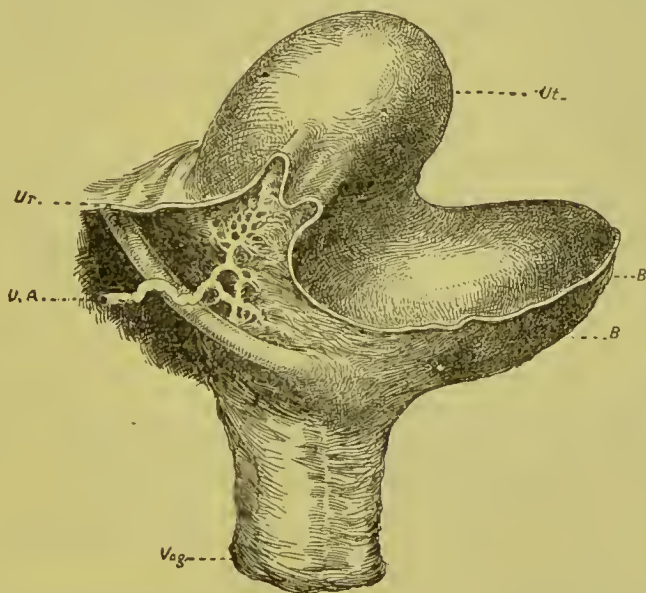


Fig. 352.—DIAGRAM SHOWING NORMAL RELATIONS OF URETER TO UTERINE ARTERY AND THE REFLEXIONS OF PERITONEUM. (From Kelly's "Operative Gynecology.")

Vag., Vagina ; B. B., Bladder ; Ut., Uterus ; U. A., Uterine Artery ; Ur., Ureter.

and scissors. The cutting should be done towards the cervix and vagina, and need not be extensive, as moderate pressure will detach the bladder wall once the interspace is opened. The uterine vessels will probably be seen.

(4) The uterine artery on each side has now to be secured close to the neck of the uterus. Its position has been referred to, and is depicted in Fig. 352. It is best picked up by a large aneurysm needle, which is passed (unthreaded) close to the cervix, and which is then threaded and withdrawn, leaving the ligature in place. In this manœuvre very great care must be taken not to damage the ureter.

When these two arteries have been secured, there remains no known vessel to supply the growth.

(5) Either the anterior or posterior fornix is now incised, and the finger introduced into the vagina; with it as a guide, the operator works round with curved scissors, taking care to keep close to the cervix. The uterine vessels are cut well beyond their points of ligature, and the ureters carefully avoided. Kelly advises preliminary catheterisation of the ureters before the operation (as first advocated by Pawlik in 1889), in order to avoid danger to them at this stage; but most operators do not consider it necessary. The important point is to keep the scissors hard on the uterus.

The tumour is removed, and if either uterine artery is badly secured it must be at once clamped and again tied.

(6) The operator searches for all bleeding points, removes the sponges or gauze which may have been introduced during the operation, and when he is thoroughly satisfied that the ligatures are holding well proceeds to sew up the vaginal roof, and subsequently the peritoneum over it, with a double row of fine silk or stouter catgut sutures (interrupted). Drainage through the vagina is unnecessary.

The usual counting of sponges is gone through, and the abdominal wound thoroughly closed.

After-treatment.—If much blood has been lost and shock is severe, free transfusion with sterile saline solution and injections of strychnia should be employed. Persistent vomiting is best treated with rectal feeding and hypodermic injections of small doses of strychnia and morphia.

Intra-abdominal hæmorrhage may necessitate reopening the abdominal wound and searching for the bleeding vessel. No complication can be more serious than this, and hence the operator should spare no trouble in making sure that all vessels are securely tied before completing the closure of the abdomen.

Wound of the ureters and imperfect ligature of vessels are the two chief dangers to be guarded against in performing hysterectomy.

With regard to the other details of after-treatment we would

refer to what has been said under the head, Abdominal Section, page 244. The sutures in the abdominal wound should be left in for ten days or a fortnight.

2. COMPLETE HYSTERECTOMY FOR CANCER BY THE ABDOMINAL METHOD.

In its main outlines this operation resembles that just described; but, whereas the operator will not be troubled by the difficulty of dealing with what is often an enormous tumour,

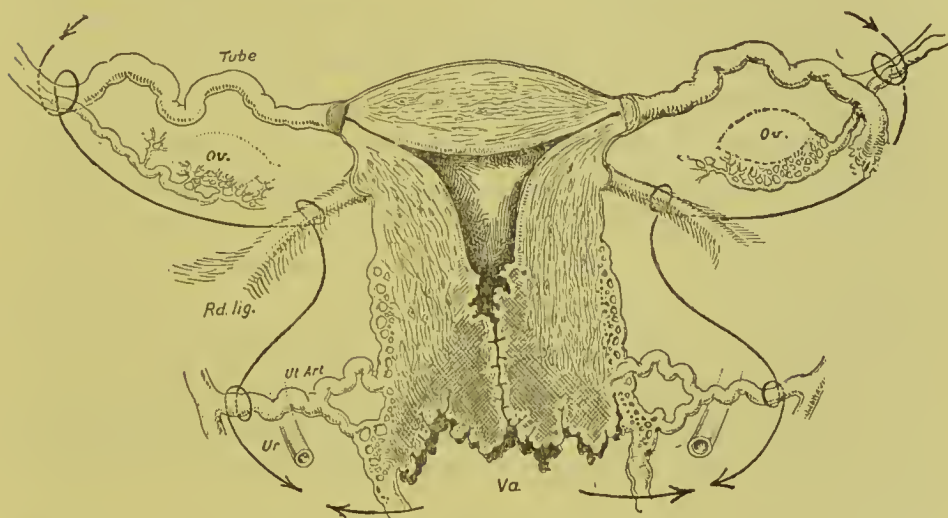


Fig. 353.—PAN-HYSTERECTOMY FOR UTERINE CANCER. (From Kelly's "Operative Gynecology.")

The sinuous line shows the order in which the structures in the broad ligament are divided, commencing with the ovarian vessels, then the round ligament and its vessels, and the uterine arteries. An opening has been made into the vagina posteriorly from Douglas's pouch, and its lateral wall is divided from within as shown by the arrows. Note relation of ureter (Ur.) to uterine vessels.

he is far more likely to meet with dangerous adhesions. In fact, the operation is not justifiable if the vagina is extensively invaded, and infiltrating adhesions to the bladder, rectum, intestines, or pelvic wall may compel him to abandon the operation.

The danger of obstruction to one or both ureters and of damage to them during the operation is greater in cases of cancer than of myoma. Prof. Kelly, whose summary of the operation is here given, urges that in all cases the ureters should be catheterised. It can be done before the anæsthetic is started

by placing the patient on her side and introducing Kelly's straight speculum into the urethra. The atmospheric pressure causes the vesical walls to separate, and the ureteral openings can usually be made out with ease. Fig. 353 illustrates the main steps of the operation, which is described, with slight alterations, in Kelly's words (from "*Op. Gynecology*," 1898, vol. ii., p. 322).

"(a) Catheters are passed into each ureter.

"(b) Administration of the anæsthetic, the patient being, of course, supine.

"(c) Thorough disinfection of the vagina, which is then filled with a loose iodoform gauze tampon.

"(d) Elevation of the pelvis and abdominal incision, exposing the field of operation.

"(e) Ligation of the upper parts of both broad ligaments, including the round ligaments.

"(f) Detachment of the vesical peritoneum, and of the bladder down to the vaginal vault.

"(g) Ligation of the right and left uterine arteries at their origin at the internal iliac arteries.

"(h) The dissection and freeing of the uterine arteries with all the adjacent cellular tissue from the pelvic wall in toward the vault of the vagina.

"(i) Setting free the ureters, which are lifted up and away from the field of operation.

"(j) Ligation of the large uterine veins above and below the ureter out near the pelvic wall.

"(k) Enlarged glands found on the pelvic floor must be taken up with the cellular tissue.

"(l) The uterus, with broad wings of connective tissue, is freed down to its vaginal attachment, and the vagina opened at least 2 centimetres below the lowest limit of the disease, anterior to the cervix, with a thermo-cautery.

"(m) The opening in the vaginal vault is continued around to the right and to the left, clamping any actively bleeding vessels until the uterus is entirely freed.

"(n) As soon as the vagina is incised anteriorly a loose iodoform gauze pack is pushed in, and as soon as the opening

is large enough to permit it the lower part of the uterus and the vaginal vault are enveloped in gauze, so as to prevent any discharge from contaminating the wound area; the gauze wrap affords an excellent hold for the operator in making traction upon the uterus as it is gradually delivered.

“(o) Bleeding vaginal vessels are controlled by catgut ligatures passed through the vaginal walls, but not including the mucosa.

“(p) The entire wound surface is minutely inspected, all oozing vessels controlled by catgut ligatures, and reinforcing ligatures applied to any important vessels where the first ligation seems insecure.

“(q) The vesical peritoneum and the peritoneum of the anterior layers of the broad ligaments are drawn back and united by continuous suture to the peritoneum of the posterior layers of the broad ligaments and Douglas’s *cul-de-sac*.

“(r) If there has been no contamination, the abdomen may be closed at once. If, however, there has been some escape of the uterine contents over the wound and into the peritoneum, the pelvic cavity should be thoroughly washed out after letting the patient down to a horizontal position before closing the abdomen.

“(s) The vaginal gauze is changed, and a piece of washed-out iodoform gauze passed loosely up between the lips of the wound to give a little support to the sutured peritoncum above, and to avoid any accumulation of fluids within the wound area.”

3. VAGINAL HYSTERECTOMY FOR CANCER.

An admirable review of the position of this operation was given by Sir John Williams in a paper in the *Lancet*, August 23, 1890. Since then Dr. A. H. N. Lewers has published several excellent papers on the subject. As I have no personal experience of this operation, I have extracted the following account—a little condensed—from Mr. Doran’s well-known work on “Gynæcological Operations” (page 318).

Instruments Required. — Clover’s crutch; Higginson’s syringe; Sims’s speculum; volsellæ; scalpels; small sponges

in holders; two pairs of long-handled scissors curved on the flat; pressure forceps; broad metal retractor; pedicle needle; needle-holder; needles; ligatures; drainage-tube.

The Operation.—The patient is placed in lithotomy position, and the lower limbs are separated by a Clover's crutch. The buttocks are brought close to the edge of the table. The surgeon sits facing the perineum. The chief assistant stands on his right, and the chief nurse on his left.

The vagina is washed out with carbolised water. The cancerous ulcer should have been previously plugged with iodoform wool, and the parts made as clean as possible.

A Sims's speculum is passed along the posterior vaginal wall. The anterior lip is seized by a volsella, and the uterus is drawn down as far as possible.

1. The assistant now takes charge of the volsella, and pulls the cervix backwards and downwards. The surgeon then cuts through the vaginal mucous membrane along its anterior reflection on to the cervix by means of the scissors, so that a semicircular wound is made in the anterior fornix, with its convexity forwards.

The hæmorrhage must be kept in check by sponging.

A catheter is passed into the bladder. The anterior part of the uterus is then cut away, with scissors, from its cellular connections with the bladder. The blades of the instrument must be kept close to the uterus. The peritoneum should not be opened at this stage.

The speculum is now removed, and the cervix completely separated from the vaginal mucous membrane. To effect this the cervix is drawn forwards, so as to bring its posterior aspect into view. The mucous membrane along its posterior reflection on to the cervix is divided with the scissors. This semicircular incision forms, with the one already made in front, a complete ring around the cervix.

2. The cervix being thus detached, Douglas's pouch is now opened up. Care must be taken not to cut too much laterally, lest the broad ligaments be wounded.

At this stage the uterus will remain connected to the sur-

rounding parts by the broad ligaments and the utero-vesical fold of peritoneum. This fold is at once divided.

In order to do so, the operator slips his left forefinger through the hole in Douglas's pouch, over the fundus and front of the body of the uterus, till the point of the finger presses on the reflection of peritoneum from the bladder on to the uterus.

The peritoneum is then divided with scalpel or scissors, the operator cutting close to the uterus, and the finger behind the peritoneum serving as a guide. The catheter should remain in the bladder during this stage.

The broad ligaments now alone remain.

3. In order to secure the broad ligaments, the fundus is pulled through the posterior part of the wound with the aid of a strong volsella. This forcible retroflexion is never easy to effect. The right hand should be pressed on the hypogastrium, whilst the left forefinger is passed through the posterior part of the wound and hooked over the fundus.

When the body of the uterus is pulled down into the wound, the operator must grasp it with the volsella.

The most dangerous stage of the operation is now reached. It is desirable that the ovaries and tubes should, if possible, be removed entire; but this cannot, as a rule, be accomplished.

The surgeon will usually have to satisfy himself with dividing the ligament on the uterine side of the ovary.

The ligament is secured by ligatures, and then cut. The difficulties of even this step will be at once appreciated. The structures to be transfixed can never be brought well into view, and it is scarcely possible to relax the ligament sufficiently while the loop is being tied.

The usual procedure—that, namely, of dividing the broad ligaments upon the uterine side of the ovary—will now be described.

A pair of large straight-bladed pressure forceps is made to grasp the broad ligament close to the uterus. A strongly curved pedicle needle armed with silk transfixes the broad ligament from behind, externally to the forceps. The ligature is then secured as in ovariectomy. As the ends of the thread are being pulled tight the assistant must remove the large

pressure forceps. The ends of the other thread are then tied round the opposite side of the broad ligament.

The broad ligament is now cut through between the ligature and the uterus. The ends of the ligature should be left uncut till the vaginal wound has been attended to later. The uterus is then drawn to the ligatured side, and the opposite broad ligament is secured in the same manner.

When the ovary and the fimbriated end of the Fallopian tube are removed the process will be far more difficult.

The ligature is very hard to apply; the tissues transfixed are upon the stretch, and the possibility of the knot slipping after it has been tied is considerable.

4. The uterus now comes away. Any remaining bleeding points must be secured by ligature.

The vaginal wound may be closed by sutures, which are inserted with a curved needle held in a needle-holder.

Some surgeons leave the vaginal wound open, and trust to packing of the vagina to prevent the prolapse of bowel or omentum through the rent.

Drainage is advisable in most cases. The simplest form of tube is a long glass drainage-tube, which is passed about half an inch beyond the vaginal wound. The vagina is then packed with iodoform wool.

After-treatment.—A thick pad of iodoform wool is laid over the vulva after the vagina has been dressed, and a sponge is placed over the mouth of the drainage-tube if that appliance has been employed. The iodoform wool plugs must be frequently inspected and changed.

When the drainage-tube is used the pelvic cavity must be washed out, should the temperature rise high or the discharge from the tube become foetid. The sutures in the vaginal wound must be removed at the end of a fortnight, a Sims's speculum being passed along the posterior wall of the vagina after the patient has been placed on her back, so as to bring the wound well into view.

Comment.—The methods for performing vaginal hysterectomy are very numerous, and have been subjected to endless variation and modification.

The chief distinctive feature of each operation turns upon the method of securing the broad ligaments.

In this, the most difficult and most important step of the operation, every device has been tried which has been carried out for the control of hæmorrhage.

Ligatures have been employed in various ways, the *écraseur* has been made use of, and the division has been effected by means of the actual cautery. Those who favour mechanical methods in operating employ a clamp; and, in spite of the objections that will naturally be raised against this clumsy method of controlling bleeding, the clamp appears to have been attended with no little success. In this particular operation the clamp is scarcely a more formidable foreign body than a glass drainage-pipe.

To readily control the bleeding, to effect a complete removal, and to take away with the uterus the ovaries and the tubes entire, it appears to me that it would be better to divide and secure the lateral attachments of the uterus through a median abdominal incision, and then to remove the organ through the vagina in the manner already described.

The uterus has been bisected from the os to the fundus, and has been removed in two segments, after the broad ligament upon either side has been secured.

The bladder and the ureter have been wounded in this operation. It is also stated that an intestinal fistula has been caused by the pressure of a drainage-tube.

As will be apparent from what has been already stated, the great danger in the operation is from hæmorrhage.

RESULTS OF HYSTERECTOMY.

The general mortality of hysterectomy for myoma, as derived from a series of combined statistics, was given by Mr. Greig Smith as about 30 per cent. On the other hand, Keith's mortality reached the remarkable proportion in most unpromising cases of only 7·9 per cent. The remarkable improvement that has taken place of late is illustrated by Dr. H. Spencer's

and Dr. T. A. Helme's combined report of thirty-eight cases with only one death (Oct., 1902).

Vaginal hysterectomy appears to be attended with a mortality of from 5 to 10 per cent. The precise prospect of "cure" of the cancer in these cases has not yet been demonstrated.

It is apparent that in a very large proportion of the cases a comparatively early recurrence takes place, and some operators have formed most gloomy views as to the prognosis. Dr. A. H. N. Lewers, by an admirable series of cases followed up, has shown that a considerable number—nearly 50 per cent.—remain free from recurrence for many years. Very much depends upon selection of cases. It may be said that it is only at an early stage of cancer, when the disease is confined to the uterus, that the operation is worth doing:

CHAPTER V.

OPERATIONS ON THE INTESTINES.

Anatomical Points.—In my Hunterian Lectures, delivered at the Royal College of Surgeons in 1885, I gave an account of the disposition of the intestines, which was founded upon the examination of one hundred fresh bodies. These bodies were all examined within twenty-four hours of death.

From the published account of these Lectures ("The Anatomy of the Intestinal Canal and Peritoneum in Man," London, 1885) the following points, bearing upon the surgery of the bowel, are abstracted :—

The average *length* of the small intestine is about twenty-three feet, and of the colon about four feet six inches.

There is no systematic *arrangement of the coils* of the small intestine. There is a disposition for the bowel to follow an irregularly curved course from left to right, but in the adult this disposition can never be relied upon. Such as it is, it may be expressed as follows. The gut, starting from the duodenum, will first occupy the contiguous parts of the left side of the epigastric and umbilical regions; the coils then fill some part of the left hypochondriac and lumbar regions; they now commonly descend into the pelvis, reappear in the left iliac quarter, and then occupy in order the hypogastric, lower umbilical, right lumbar, and right iliac regions. Before reaching the latter situation they usually descend again into the pelvis.

The coils most usually found in the pelvis belong to the lower ileum, and to the bowel between two points respectively six feet and twelve feet from the duodenum.

In examining a coil of protruded small intestine, the follow-

ing points may be made use of to *distinguish jejunum from ileum*.

The jejunum is wider than the ileum, its coats are thicker and more vascular, and the valvulæ conniventes—as seen on holding the coil to the light—are large and well marked. These folds are absent in the lower ileum, while it is in that part of the canal that Peyer's patches are most distinct.

With regard to the *mesentery*, its upper or right layer is continuous with the under layer of the transverse mesocolon, and with the peritoneum that invests the ascending colon: Its lower or left layer joins with the serous membrane that encloses the descending colon, that forms the sigmoid mesentery, and that descends over the lumbo-sacral eminence into the pelvis.

The parietal attachment of the mesentery is liable to considerable variation. It commences at the end of the duodenum, just to the left of the spine, and thence follows an oblique line which runs downwards and to the right, crossing the great vessels, and ending in a somewhat uncertain manner in some part of the iliac fossa. The mesentery becomes elongated in hernia, and is liable to many congenital variations.

With regard to the visceral attachment of the mesentery, attention must be drawn to the excellent and practical investigations of Mr. Wm. Anderson ("Mac Cormac on Abdominal Section," London, 1887, pages 25 and 80):—"Owing to the divergence of the two layers of the mesentery as they approach the bowel, a portion of the circumference of the jejunum and ileum is destitute of serous investment. The separation of the laminae of the mesentery begins at a distance of about two-thirds or three-fourths of an inch from the intestine, and leaves a triangular space, the base of which, averaging about five-sixteenths of an inch in width, is formed by the uncovered muscular tunic. This interspace is occupied by fat, by the vessels and nerves of the gut, and by delicate fibres of connective tissue (Fig. 354).

"Unless this disposition of the peritoneum be taken into account, it is obvious that a suture applied in the manner of Lembert might fail to bring into contact the true wall of the

intestine at the mesenteric attachment, and a leakage from the interior of the tube might take place into the interserous triangle and peritoneal cavity.

“The *disposition of the arteries* within the triangle is worthy of notice. The last row of anastomotic loops, from which arise the direct branches of supply, is placed much nearer to the intestinal wall in the lower than in the upper portion of the bowel, and towards the termination of the ileum commonly lies within one-third of an inch of the canal. From these loops are given off, at moderately regular intervals, straight vessels, which do not intercommunicate, but pass at once to the muscular floor of the triangle, either to pierce it on each side near the lateral angles of the interspace, or to run for a short distance between the serous and muscular tunics before entering the latter. As each of these vessels has a fairly well-defined territory, it appears undesirable to interfere with the loops from which they spring, and it is hence safer to divide the mesentery as close as possible to the portion of bowel to be resected, the cut edges of the redundant part left after suture of the intestine being folded and the edges united by fine catgut sutures.

“It is important to remember that the thickness of the *muscular coat* of the small intestine varies within rather wide limits in different subjects, and in all cases diminishes, together with the calibre of the tube, from the upper towards the lower extremity of the canal. In the jejunum, about two feet from the commencement, the depth of the tissue ranges from one-seventieth to one-fortieth of an inch, while in the lower part of the ileum, about two feet from the ileo-cæcal valve, the thickness is reduced to about one-half or even one-third of this measurement. The difficulty and danger of enteroraphy

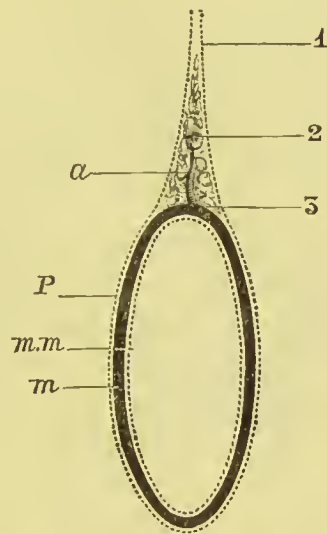


Fig. 354.—SECTION OF SMALL INTESTINE AND MESENTERY.

1, Mesentery; 2, Triangular space; 3, Base of triangle; P, Peritoneum; m, Muscular coat; m.m, Mucous coat; a, Artery to bowel.

will hence be greater the more remote the portion of intestine is from the stomach; but fewer sutures will be needed.

“The *submucous tissue* has a considerable degree of toughness, and is usually thick enough to bear a fine suture, applied after Lembert’s manner, without implicating the epithelial surface of the mucous membrane.”

In connection with the last-mentioned point, it must be borne in mind that the glands of Lieberkühn penetrate the mucous membrane for some distance, and that if the suture pass through them the lumen of the bowel is practically opened. The tough submucous tissue is air-tight and water-tight. It is much better marked in many animals used for experiments (*e.g.* dogs and cats) than in man.

The *cæcum* is always entirely covered by peritoneum. In shape and in position it is liable to considerable variations, some of which may be congenital, while others are acquired. The *cæcum* usually lies upon the psoas muscle, its apex corresponding with a point a little to the inner side of the middle of Poupart’s ligament.

The *appendix* is subject to very numerous variations, both as to shape and to situation. It commonly lies behind the end of the ileum. It is often in close relation with the iliac vessels and the ureter. It is not unfrequently found in the pelvis.

The general disposition of the *colon* need not be here described.

I made a careful examination of the peritoneal investments of the ascending and descending parts of the colon in one hundred bodies, with the following result. In fifty-two bodies there was neither an ascending nor a descending mesocolon. In twenty-two there was a descending mesocolon, but no corresponding fold on the other side. In fourteen subjects there was a mesocolon to both the ascending and the descending segments of the bowel; while in the remaining twelve bodies there was an ascending mesocolon, but no corresponding fold on the left side.

It follows, therefore, that in performing lumbar colotomy a mesocolon may be expected upon the left side in 36

per cent. of all cases, and on the right side in 26 per cent.

The line of attachment of the left mesocolon is usually along the outer border of the kidney, and is vertical; that of the right is less vertical, and crosses the lower end of the kidney from right to left, to ascend along the inner margin of the gland.

The so-called *sigmoid flexure* forms, as I have pointed out in the Lectures alluded to, a loop which resembles a capital omega, but which cannot be called sigmoid (Fig. 355). This omega loop extends from the point of ending of the descending colon—at the outer border of the psoas—to the middle of the sacrum. It includes therefore, what is known as the first part of the rectum. Its average length in the adult is seventeen and a half inches. The mobility of the loop is remarkable. Its mesocolon is quite distinctive. Its average length is as follows: Over the psoas, one inch and a half; at the bifurcation of the common iliac vessels, three and a half inches; on the sacrum, one inch and three-quarters (see Fig. 355). The outline of the loop, when spread out, is much influenced by changes in the sigmoid mesocolon. Some notable variations in the outline of the omega loop are shown in Fig. 356. These matters are of concern in the operation of inguinal colotomy.

The intersigmoid fossa is in this mesocolon. It is the seat of the intersigmoid hernia, and at its neck is the sigmoid artery.

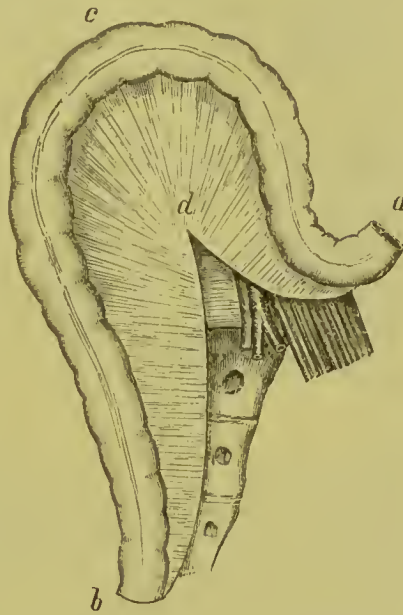


Fig. 355.—THE SIGMOID FLEXURE OR OMEGA LOOP.

a, End of descending colon; *b*, Lower part of rectum; *c*, Summit of the loop; *d*, Neck of the sigmoid mesocolon.

SUTURE OF THE INTESTINE.

The first principles of intestinal surgery involve a consideration of the best method to be adopted for closing wounds and breaches in the bowel, and for bringing together the divided ends of the tube when a segment of the intestine has been resected.

The future of the most elaborate and the most promising operation upon the intestinal canal may depend upon the



Fig. 356.—DIAGRAM TO SHOW THE OUTLINES OF THE SIGMOID FLEXURE OR OMEGA LOOP AS OCCASIONALLY MET WITH.

integrity of a few sutures. If one stitch fail, the wound in the gut may gape, and faecal matter may escape.

It may be said literally of some intestinal operations that their success hangs upon a thread.

The history of the suture as applied to the intestine, or the development of the operation of enteroraphy, as some term it, is full of interest.

No more valuable contribution to our knowledge of the subject has been provided than that afforded by Travers's famous monograph, "An Enquiry into the Processes of Nature in Repairing Injuries of the Intestine," published in 1812. An excellent *précis* of the development of this branch of intestinal surgery is to be found in South's edition of "Chelius's Surgery" (vol. i., page 456).

To Ramdohr in 1780 ("Moebii Dissert. Obs. Misc. Helmst.,"

1780) is ascribed the honour of having been the first to successfully unite the bowel by suture after complete division.

Since this time invention has run riot among methods for uniting the intestine, and the forms of suture which have been considered as especially adapted to the bowel are now legion.

The methods devised have been not only very numerous, but also very varied. Some are imperfect, others are bizarre, not a few are merely curious, many are ingenious, the majority are elaborate.

It is possible, however, to arrange the greater number of the procedures that have been devised under the following divisions or plans:—

Methods.—1. The divided bowel is brought into the abdominal wound and is retained there. No immediate attempt is made to close the breach in the intestine. An artificial anus is of necessity established. The closure of this fæcal fistula is left to a subsequent period.

This method was advised by John Bell. It can very rarely be employed.

2. The two halves of a Murphy's button are secured by suture in each end of the divided intestine, and are then fitted together. Sometimes a few additional Lembert's sutures are added, but reliance is mainly placed on a plastic inflammation, due to the pressure of the button, producing union before the button itself works loose in the intestine.

3. A rigid cylinder of decalcified bone (the so-called "bobbin") is introduced, and over this the two ends of the bowel are drawn and so united as to cover in the cylinder. The cylinder, or bobbin, facilitates the introduction of the stitches, and so shortens the time taken in suturing; it also acts as a temporary splint, and allows the passage of intestinal contents through its lumen. It may be noted, however, that it soon becomes digested or works loose. Thus Mr. Watson Cheyne, in one case, records that it was vomited up half digested only nine hours after it had been inserted in doing gastro-jejunostomy.

4. One end of the bowel is invaginated into the other. If possible, the upper end is introduced into the lower. This

method was first practised by Ramdohr in 1780, and has been extensively modified. The earlier operators brought the outer serous coat of the inner or entering segment of the bowel into contact with the mucous lining of the outer or receiving segment. In 1827 Jobert so modified this procedure that the serous coats of both ends of the bowel were brought into contact with one another. To effect this the free (divided) edge of the lower or receiving segment of the intestine was turned inwards.

Invagination is now chiefly employed in the form of Maun-

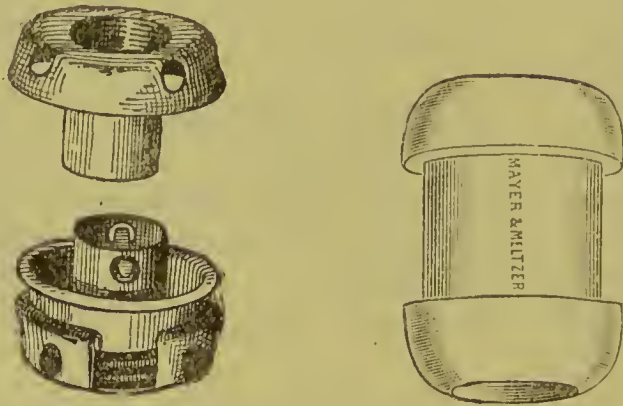


Fig. 357.—MURPHY'S BUTTON AND ROBSON'S BOBBIN.

The left-hand figure shows the small size of Murphy's button suitable for use in the small intestine. The right-hand figure shows Robson's Decalcified Bone Bobbin.

sell's operation, and then only as a temporary method to aid accurate suturing (*see* page 302).

5. The divided margins of the bowel to be treated are brought together by means of some form of suture. This is effected without employing any supporting foreign body, and without producing any invagination of the tube.

A great variety of *sutures* has been devised to effect this object.

The principal and most generally accepted methods of uniting the divided intestine will now be described. These selected methods represent the chief modern procedures concerned in enterography.

Qualifications of a Good Suture.—An efficient intestinal suture should have the following qualifications:—

1. It should bring into contact two broad surfaces of

peritoneum, these surfaces belonging respectively to the bowel above and below the breach to be closed.

2. It should effect a complete closure of the wound, the test being that the seam should be water-tight.

3. The suture should be simple, should be easily introduced, and should be capable of effecting a rapid closure of the wound.

4. The thread should take so firm a hold of the tissues that there is no danger of its "cutting out" when strain is put upon it, as may be the case if the viscus become distended.

5. The sutures passing through the mucous membrane should be reinforced by a second row, which includes only the outer coats of the bowel.

6. No unsupported suture should pass through all coats of the bowel—*i.e.* it should not pass from the lumen of the gut to the serous covering of the same.

7. Special care should be taken at the mesenteric attachment to effect close union, as leakage is very apt to occur at this point.

The chief forms of intestinal suture will now be considered.

A. The Continuous Suture.

1. *Dupuytren's Method* (*Méd. Opér.*, vol. ii., page 138, Paris, 1822).—The edges of the wound are turned inwards, and the opposed folds of serous membrane are then brought together by means of the ordinary continuous suture (Fig. 358). The suture does not involve the mucous membrane. This suture may be very rapidly applied.



Fig. 358.—DUPUYTREN'S SUTURE.

The method of commencing and finishing a continuous suture is illustrated in Fig. 359.

Some surgeons advocate that the suture should pass through all the coats of the intestine, a second row of interrupted Lembert's sutures or a continuous one (in either case involving only the outer coats) being added. This procedure involves an unnecessarily large amount of the bowel wall.

2. *Gély's Method* (*Nouv. Dict. de Méd. et de Chir.*, vol. xix., page 237).—A long thread is armed at either end with a simple

straight round needle. One needle is introduced 4 to 5 mm. behind, and to the outer side of one end of, the wound, and is made to traverse the outer coats of the bowel in a direction

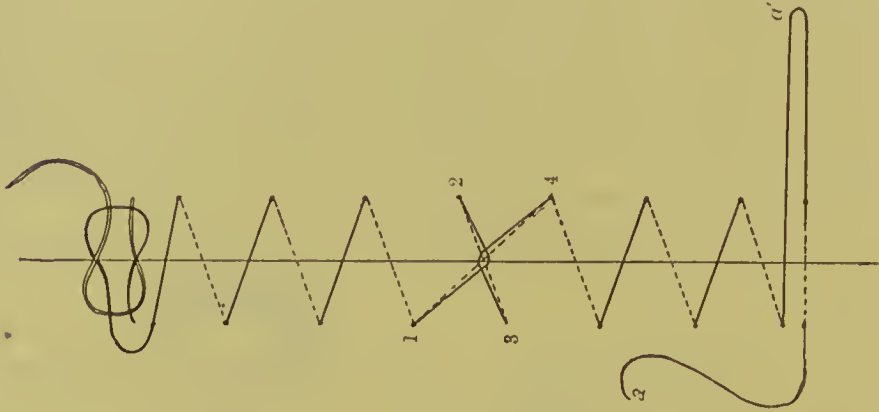


Fig. 359.—A CONTINUOUS SUTURE RUNNING FROM LEFT TO RIGHT.

A double knot is tied at the commencement. After traversing a short distance, the suture is tightened and secured by a loop (1, 2, 3, 4); at its end a second knot is made by tying the single thread (*a*) with the loop (*a'*) in a double knot.

parallel to the edge of the wound for a distance of 4 to 5 mm. The same procedure is carried out with the other needle upon the opposite side of the breach (Fig. 360). The needles are

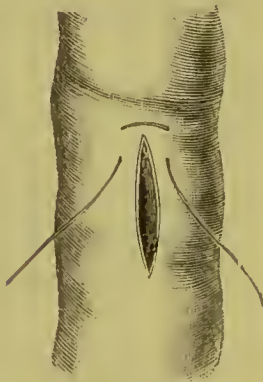


Fig. 360.—GÉLY'S SUTURE :
FIRST STAGE.

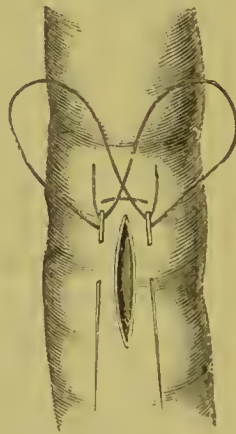


Fig. 361.—GÉLY'S SUTURE :
SECOND STAGE.

then crossed, and precisely similar stitches are taken on either side of the wound, care being exercised that the needle enters the hole which has been already made by the opposite needle in making the previous stitch (Fig. 361).

Like stitches are taken along the whole length of the wound (Fig. 362). In order to close the wound, each transverse thread

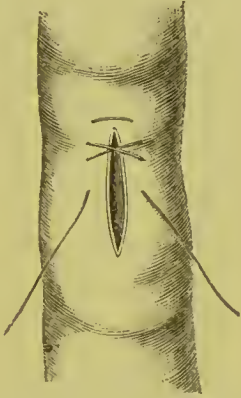


Fig. 362.—GÉLY'S SUTURE:
THIRD STAGE.

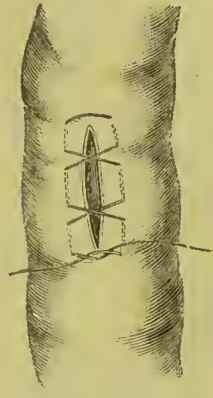


Fig. 363.—GÉLY'S SUTURE COM-
PLETE: THREADS READY TO
BE DRAWN TIGHT.

is drawn tight by dissecting forceps, the margins of the wound being at the same time depressed. The opposed serous surfaces

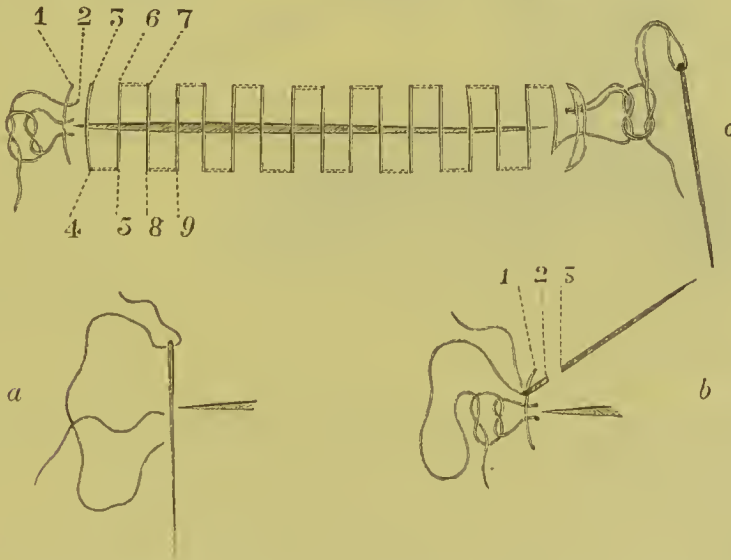


Fig. 364.—THE RIGHT-ANGLE CONTINUOUS INTESTINAL SUTURE.

a, Beginning of suture; *b*, Knotting of the same; *c*, The right-angle suture applied. (The numbers 1, 2, 3, in Figs. *b* and *c*, point to the same needle punctures; the numbers 4 to 9 indicate, in order, the track of the needle.)

are thus brought into close contact, and the threads are lost to view. The two threads are finally knotted at the end of the wound opposite to that at which the suture was commenced (Fig. 363).

3. *The Right-Angle Continuous Suture.*—This is described and advocated by Dr. Cushing in a well-illustrated pamphlet published in Boston in 1889. The stitch is a modification of that known as Appolito's. The suture is commenced as shown in Fig. 364, *a*. It is knotted as soon as a hold upon the bowel has been obtained (Fig. 364, *b*), and the right-angle stitches are now commenced.

The thread is then carried to and fro across the wound as shown in Fig. 364, *c*, and is finally knotted at the far extremity of the breach after the manner illustrated in the woodcut.

The great feature of the suture consists in this—that the needle never enters the lumen of the bowel. The tissues are picked up by passing the needle parallel to the line of the wound. The needle passes through the serous and muscular coats, but avoids the mucous.

In the illustration it will be observed that the needle after

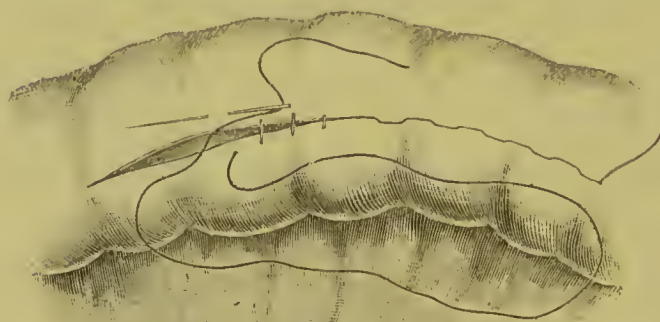


Fig. 365.—THE RIGHT-ANGLE CONTINUOUS SUTURE.

leaving the puncture 3 is carried across the wound. It then picks up the tissues from 4 to 5 (at right angles to its course and also parallel to the wound). The thread is carried

once more across the wound, and is made to pick up the tissues from 6 to 7, and so on:

When the suture is drawn tight the thread becomes buried, as shown in the right-hand part of the half-closed wound in Fig. 365.

The method of knotting at either end is unnecessarily complex.

Many other forms of continuous suture are employed. I believe the three selected to represent the best. The suture known as the glover's suture is totally unsuited for the intestine.

B. The Interrupted Suture.

1. *Lembert's Suture* was first described in 1826 (*Répertoire Gén. d'Anat. et de Phys. Path.*, vol. ii., June 3, 1826).

The needle is passed transversely to the line of the wound, and at right angles to the axis of the bowel.

A fold is picked up upon one side of the wound ; the needle is then carried over to the corresponding spot on the other side of the wound, where a precisely similar fold is picked up (Fig. 366).

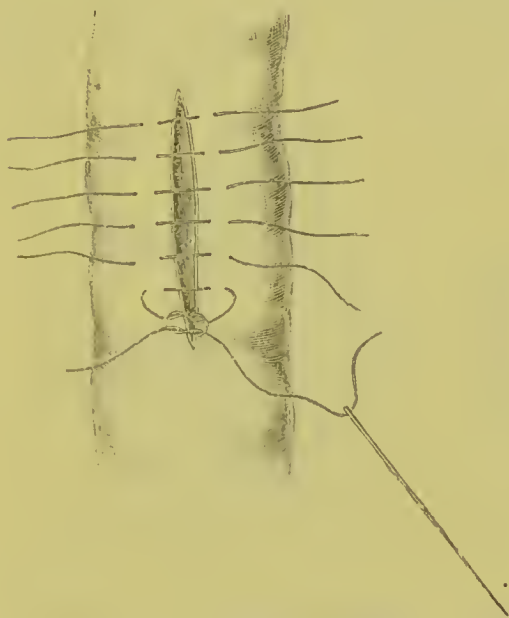


Fig. 366.—LEMBERT'S SUTURE

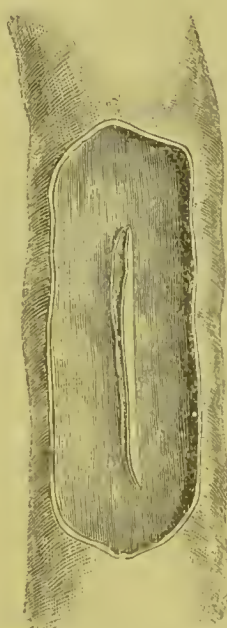


Fig. 367.—LEMBERT'S SUTURE OF THE INTESTINE (as seen from the mucous surface).

The margins of the wound are turned in, and the serous coats are brought into close contact (Figs. 367 and 368). The needle should pick up more than the serous coat ; it should include a part or the whole of the muscular coat also. It must on no account trespass beyond the limits of the submucous layer (Fig. 368).

The width of the fold picked up will be from one-tenth to one-twelfth of an inch. The inner row of needle points will be from one-twelfth of an inch to one-eighth of an inch from the edge of the wound. In very small and simple wounds of the intestine the needle may be brought out nearer to the free border of the gap to be closed. The amount of tissue

picked up, *i.e.* the width of the fold, will depend upon the thickness of the tissues involved, the amount of strain likely to be brought upon the sutures, and the character of the breach to be closed.

The closeness of the sutures to one another must vary somewhat according to circumstances. They may be usually estimated at about ten to the inch. It will rarely be safe to apply them less closely than this.

The extremities of each suture are knotted together, and the ends cut short. The knots need not be tied with the utmost degree of tightness.

Much trouble is saved, and the inconvenience of a long, wet,

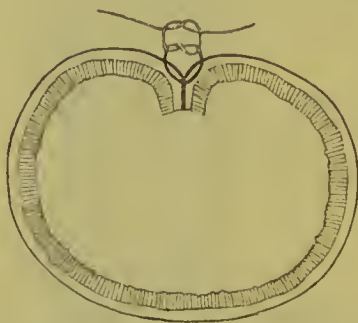


Fig. 368.—LEMBERT'S SUTURE.

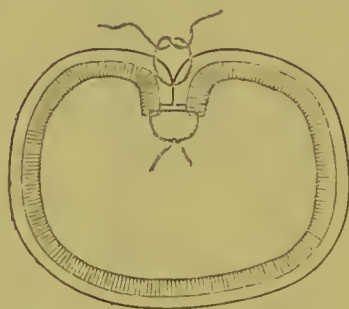


Fig. 369.—CZERNY-LEMBERT SUTURE.

and sticky thread is avoided, if separate threaded needles are prepared for each suture.

If the supply of needles be limited, the thread carried by each needle may serve for two, or at the very utmost for three, sutures.

No form of intestinal suture can surpass Lembert's for general usefulness.

2. *Czerny's Suture* (*Sammlung klin. Vorträge*, 1881, No. 201).—This is a Lembert's suture with the addition of an inner row of interrupted sutures which unite the mucous membrane only (Fig. 369). The knots of this inner row are turned inwards. In the case of small or limited wounds of the bowel, and in the case of the nearly closed wound which results from suturing the divided ends of the bowel after resection, the knots of the inner layer of sutures must of necessity be tied towards the outer

surface of the tube. The ends of the suture are cut short, and the row of knots is inverted as far as is possible. The row of knots is then covered in by the muscular coat, when Lembert's suture is applied.

C. **The Invagination Method.**—This has been applied only in instances in which the whole circumference of the bowel has been divided.

1. *Jobert's Method.*—This was described in 1827 (*Mém. sur les Plaies du Canal Intestin.*, Paris, 1827).

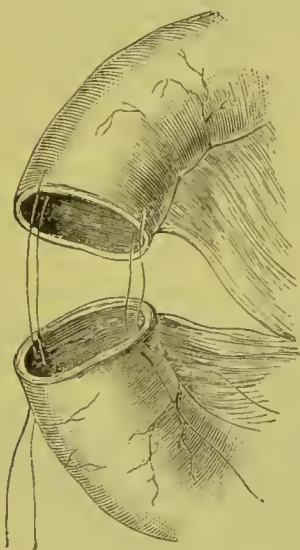


Fig. 370.—JOBERT'S SUTURE FOR THE INTESTINE (sutures placed preparatory to invagination).

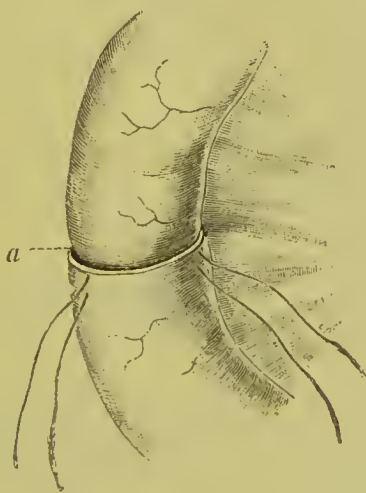


Fig. 371.—JOBERT'S SUTURE FOR THE INTESTINE.

a, Line of invagination of the upper segment into the lower.

The upper and lower ends of the gut having been identified, the mesentery is dissected away for one-third of an inch from each end of the bowel. A straight needle carrying a long thread is then made to transfix the upper segment about a third of an inch from the divided margin, and along the line of the mesenteric attachment. A like suture is introduced upon the opposite (free) margin of the bowel (Fig. 370).

The margin of the lower end of the gut is now invaginated. This is a difficult manœuvre to effect.

The two ends of the thread hanging from the upper end of the bowel are both armed with needles, and the double fold of the intestinal wall produced by the invagination is transfixed

by the two needles, which will pierce the gut at a little distance from one another. A like plan is adopted with both the sutures. The threads will pass through corresponding parts of the two segments of the bowel. The upper end of the bowel is now forced into the lower, partly by traction upon the sutures, and partly by squeezing. The serous coats of both of the ends of the gut are thus brought into contact (Fig. 371). The ends of the sutures are finally knotted externally upon the outer surface of the lower segment of the divided intestine.

To make this method secure the two segments of the bowel should be transfixed by at least four sutures instead of two, and the peritoneal surfaces on the outer aspect of the tube at the point where the two segments meet should be brought together by numerous points of Lembert's suture.

2. *Maunsell's Method*.—The principle of this method is to secure close apposition of the ends of the gut by a row of sutures which pass through all the coats of the intestine from within outwards, and with the knots placed on the inside of the gut.

The following account is derived from the *International Journal of the Medical Sciences*, 1892, page 245. The portion of intestine having been excised, the two ends of the bowel are brought together by two temporary sutures which pass through all the coats of both ends of the gut. One suture is placed at the mesenteric attachment of the bowel (*b*), and the other at the free margin (*a*) (Fig. 372, A). The ends of these sutures—which are loosely knotted—are left long. An opening is now made at *c* (Fig. 372, B) in that segment of gut which is the larger of the two—*i.e.* in the proximal part. The incision is on the free border of the bowel, and in its long axis. It will be placed about an inch from the free end of the gut, and its size will depend upon that of the gut to be invaginated. The ends of the ligatures *a* and *b* are introduced into the lumen of the incised bowel, and are brought out through the incision *c* (Fig. 372, B). They are then dragged up so as to invaginate the bowel, and ultimately to bring out the two divided ends of the intestine *d* through the incision *c* (Fig. 372, C). The surgeon now passes a fine straight needle *e* through both sides of the double tube of bowel *d*. The suture is hooked up where it

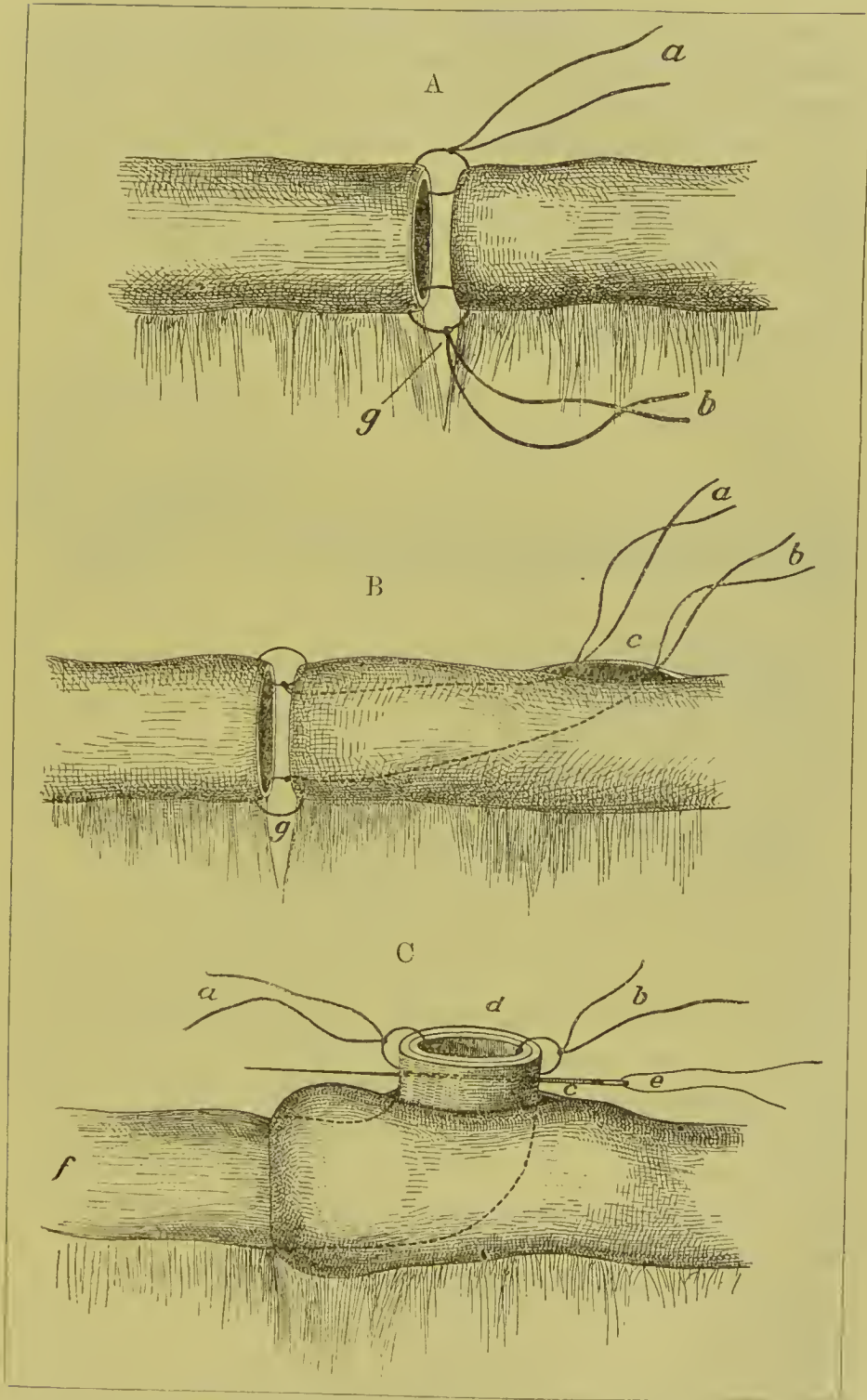


Fig. 372.—MAUNSELL'S METHOD OF UNITING INTESTINE BY THE PROCESS OF INVAGINATION. (For references, *see text*.)

crosses the lumen of this tube, is divided, and tied on either side. In this way twenty sutures can be introduced with ten passages of the needle. The sutures are of fine silk, and serve to unite the divided intestine. Finally the ligatures *a* and *b* are removed, and the sutured gut *d* is withdrawn (in the direction *f*), the invagination being thus reduced. The longitudinal incision *c* is then closed by Czerny-Lembert sutures, and the slit in the mesentery at *g* is also closed by sutures. The united bowel will now appear to be quite straight, and no sutures will be visible.

D. Adjustment by the Intervention of Foreign Bodies.

Suture over a Decalcified Bone Bobbin.—Mayo Robson's bobbin (Fig. 357) is the best form to employ; it is kept ready decalcified in spirit in various sizes. In performing end-to-end union of intestine the largest bobbin that will fit the intestine is selected. Before introducing it, a continuous suture of silk (some employ catgut) is started on the posterior halves of the intestinal ends. This suture traverses all the coats, except the serous and outer muscular coats. The bobbin is now inserted, and held in place between finger and thumb of the assistant (acting through the intestinal wall). The continuous stitch is then carried all round the cut edges with here and there interruptions to make the suture tight. A second row of Lembert's interrupted sutures, which traverse only the outer coats down to the submucous layer, completes the union. Instead of these, the outer suture may be made continuous, but in our belief nothing ensures such perfect apposition as Lembert's interrupted stitches. Especial care is bestowed on the mesenteric border. The bone bobbin is probably of use only for a few hours after the operation (*see* page 293).

The *Rubber Bag* (which has long been abandoned) and *Laplace's Forceps* require no description, as they are both quite unnecessary and awkward to employ.

Senn's Plates have entirely gone out of use.

Murphy's Button.—With the aid of this ingenious instrument, which was introduced by J. B. Murphy of Chicago in 1895, the surgeon can undoubtedly effect end-to-end union or lateral anastomosis in a shorter time than by any other method.

It must be clearly understood that the button produces a plastic inflammation, and, indeed, a variable amount of pressure necrosis. This necrosis ultimately sets the button free, and after some days it passes on into the bowel below. When the button becomes free the plastic union may happen to be just sufficient, or it may be incomplete and leakage may result.

The method of employing the button (attempted modifications of which have at present effected no improvement) will

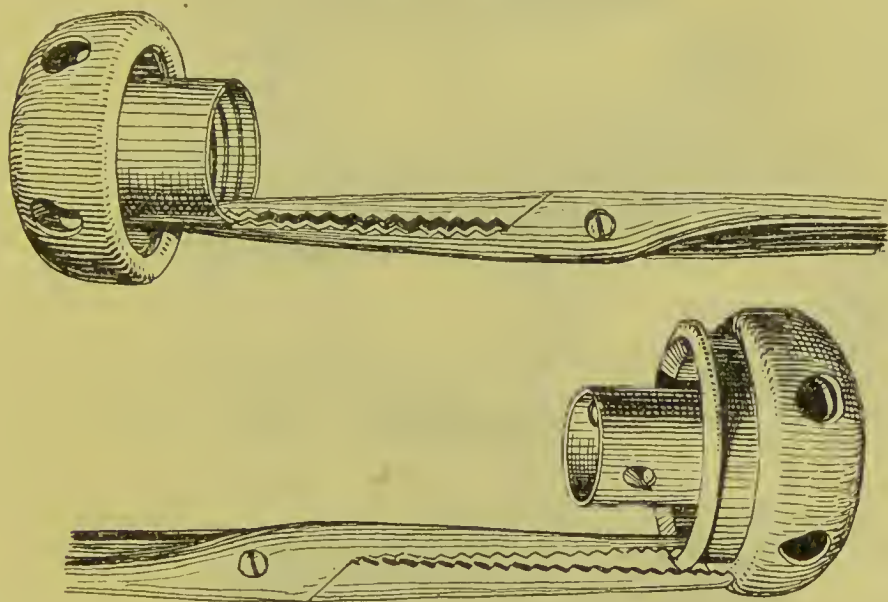


Fig. 373.—MURPHY'S BUTTON. (The lower is the heavier or male half of the button. The spring is seen in the interior.)

be gathered from the accompanying figures (373, 374, 375, 376) more readily than from a long description.

The two ends of the intestine are clamped or held between the fingers of an assistant some distance from their cut edges. A running silk suture is rapidly carried round each edge, traversing all the coats; it should begin at the mesenteric attachment, and its free ends are not tied.

In performing lateral anastomosis or gastro-jejuno-stomy, the running suture is introduced before the intestine is opened. This suture is arranged as shown in the figure, and passes only through the serous and muscular coats of the bowel.

The two halves of the button are then inserted by means of

forceps (Fig. 373); their lumen may be lightly plugged with cotton-wool, which is, of course, removed just before they are fitted together. The heavy "male" half is inserted into the lower segment of bowel, or in gastro-jejunostomy into the jejunum. The stitch is tied securely round the narrowest part of each half, and is cut short. Any redundant mucous membrane is

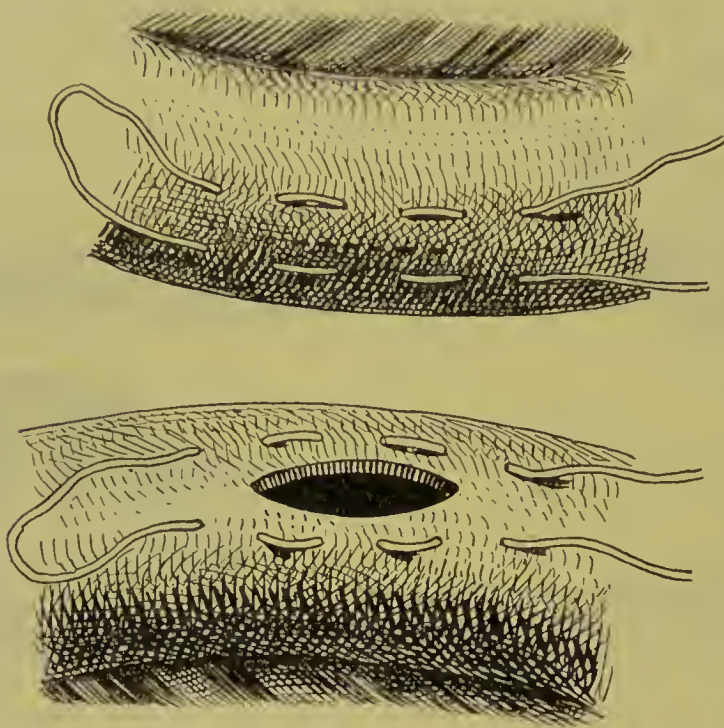


Fig. 374.—INTESTINE READY FOR THE INTRODUCTION OF MURPHY'S BUTTON.

(In the upper figure the suture is inserted. In the lower figure the incision for the insertion of the button has been made.)

cut off with scissors. The two halves are then fitted to each other, care being taken that they are pressed home with just sufficient force to secure close approximation. It is in this manœuvre that accidents are apt to occur; the halves of the button may jam, the ends of the bowel may be twisted in bringing them together, or the buttons may be forced together too tightly. The mistake has occasionally been made of trying to fit buttons of two different sizes together. Finally, a few Lembert's sutures may be applied, but they are not essential.

The time taken in placing the sutures and button need not

exceed ten to fifteen minutes, whereas any other satisfactory method will take from thirty minutes to an hour.

Best Form of Intestinal Suture.—In discussing this question, operations on the stomach may well be included with those on the intestines. What holds good with regard to end-to-end union or lateral anastomosis of intestine applies equally to gastro-jejunostomy, etc. The chief point to

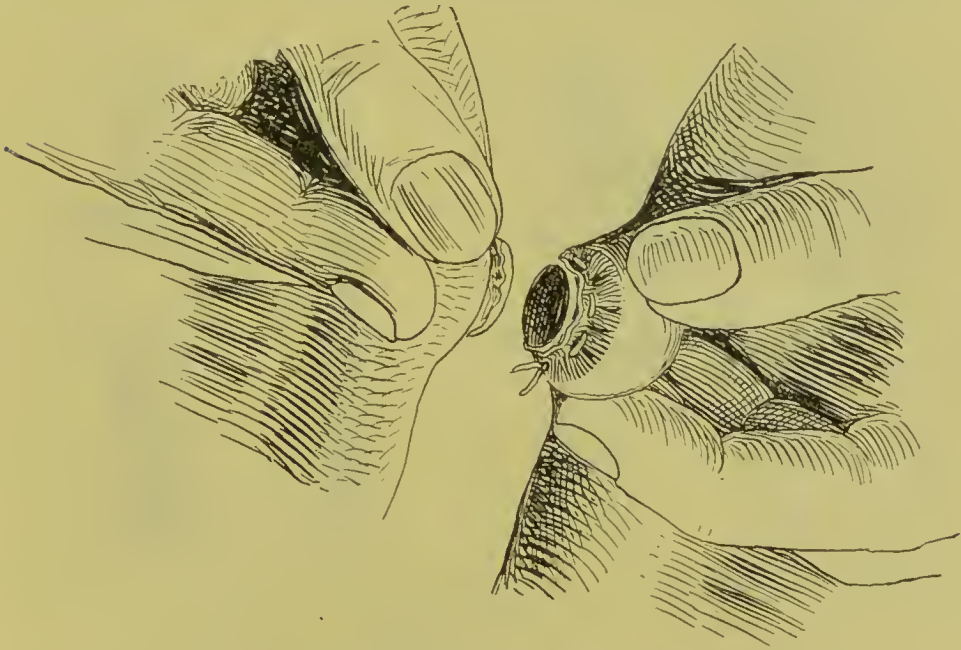


Fig. 375.—MURPHY'S BUTTON IN LATERAL ANASTOMOSIS.

Showing the method of holding the button when bringing the two halves together.

be considered is whether *Murphy's button* or a *double row of sutures* should be employed. No other mechanical appliance than the button has proved really effective, Mayo Robson's bobbin being merely an aid to suturing. The bobbin, however, may be of decided use, especially in certain cases, such as in the closure of a faecal fistula.

It was thought at one time that the use of Murphy's button, with its very conspicuous advantage of rapidity in operating, would supplant simple suturing. Most surgeons have, however, after trial of the button, returned to the use of direct suture. Resection of gangrenous gut in hernia operations affords a fair test of the relative merits of the two methods. In a paper in the

Clin. Soc. Transactions for 1900, p. 71, one of us (J. H.) has shown that the percentage of recoveries is considerably higher after suturing than after the use of Murphy's button. Out of fourteen such cases treated with Murphy's button, only one recovered (*i.e.* 7 per cent.); whilst of fifteen treated by suturing, seven recovered (*i.e.* 46 per cent.). Mr. Kendal Franks (*Med. Chir. Trans.*, 1893) collected a series of cases treated by suturing

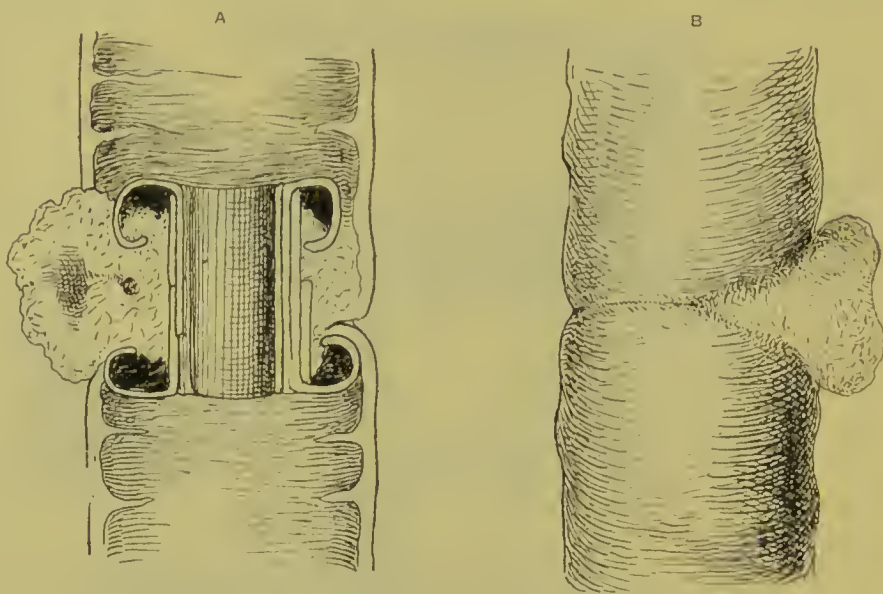


Fig. 376.—MURPHY'S BUTTON USED IN END-TO-END UNION.

From a specimen placed in the Royal College of Surgeons Museum by Mr. P. Furnivall.

A, sectional view of intestine, shows the button *in situ*: B, External view of intestine—the lateral projection is composed in part of fat at the mesenteric border.

alone after resection, with a similar percentage of recoveries (rather under 50 per cent.).

In the allied operation of gastro-jejunostomy statistics show a similar advantage of direct suture over the use of Murphy's button, though not in the same proportion as in resection of intestine.

Moreover, in practised hands the somewhat longer time taken by suturing does not appear to have the injurious effect attributed to it. There is a disadvantage in leaving a heavy metal body in the intestine or stomach, and accidents have occasionally happened from this cause alone. The retained button has caused ulceration, and has had to be removed by

operation. The opening made by the button is very apt to contract. This is shown in certain specimens I have deposited in the Royal College of Surgeons Museum. Still, when it is all important to finish the operation quickly, Murphy's button affords the best means of doing so.

Maunsell's method by invagination cannot be strongly recommended; it involves two wounds of the intestine, and is often more difficult than the description leads one to suppose.

For the *continuous sutures* the following advantages are claimed:—The suture is readily and rapidly applied. Time is not lost in tying some twenty or thirty knots with very fine silk or catgut which is wet and sticky. The suture is strong, takes a firm hold of the parts, and can sustain considerable strain. It produces a very perfect apposition of the margins of the wound.

The objections to it are these:—A considerable length of ligature material is left in the coats of the intestine. It is not always easy to pull all parts of the suture evenly tight. Some part of the thread is apt to be loosened as the gut contracts; some strangulation of the margins of the gut to be united is apt to follow when the suture is drawn tight. Practically the whole of the circumference of the bowel is gripped by the suture.

The *right-angle continuous suture* is, on the whole, the best of the three named. The apposition of the surfaces is very complete and very neat. The suture is buried. The disposition to produce strangulation of the margin of the wound is scarcely more than is to be noted in the interrupted suture.

It is obvious that the edge of the intestine must be turned inwards by these sutures, but there is no fear of producing undue narrowing of the lumen, provided reasonable care is employed. In one case of end-to-end union, after resection of several inches of small intestine (J. H.), the specimen was obtained four years later. A fine scar was all that remained to mark the site of resection; there was not the slightest narrowing. It is of interest to note that all the silk stitches had disappeared.

The interrupted sutures have many advantages. The strain

upon the wound is distributed over many threads. The surfaces concerned are brought into very accurate contact. The vascular supply of the margin of the wound is not interfered with. The sutures are easily introduced, and the amount of suture material employed is reduced to a minimum. The securing of these sutures, however, involves considerable time; and, unless they are very closely placed together, there is some risk of leakage in the gaps between the threads.

Lembert's suture has stood the test of time, and it may be safely said of it that it is, on the whole, the *best form of suture* with which we are acquainted.

Its extreme simplicity, the rapidity with which each stitch can be inserted, and its undoubted safety and efficiency are points in its favour which all operators have recognised. Whenever time permits—and, indeed, whenever it is possible—the Czerny-Lembert suture should be the form of this suture employed.

Needles Employed.—The needles selected for suture of the intestine must depend upon the taste and custom of the individual operator. A straight, slender sewing-needle has appeared to me to be the best in most cases, and is especially suited for Lembert's suture. Sutures in the mucous membrane are perhaps more conveniently introduced by means of a curved needle. A curved needle is also used by many for the superficial sutures.

The straight needle should be about one inch and a quarter in length, and must have a round shaft. A common sewing-needle of this length is excellent, and is infinitely to be preferred to the lancet-pointed or triangular-pointed needles often found in use.

The curved needle should have a round shaft, should form a complete semicircle with a diameter of about five-eighths of an inch, and the extremity of the eye should not be larger than the rest of the shaft. It should not taper too much towards the point, but the full size of the shaft should be reached a short distance from the point. Many of the special "intestinal needles" are needlessly small.

The simplest possible form of needle-holder should be used.

I have not found either Hagedorn's needle or his needle-holder convenient for suturing the intestine.

Possibly the worst form of intestinal needle is that known in instrument makers' catalogues as the "half-curved."

Sutures Employed.—I have found the best suture material to be the very finest braided silk, stained red, so that it can be easily seen. It is strong, is easily manipulated, is of close fibre, runs very easily, and ties in a very small and very firm knot. It does not twist up, and is even more easy to deal with when it is wet than when it is dry. It should, indeed, always be used wet.

Fine catgut is employed by many, but it has certain drawbacks. There is no catgut made which has so smooth a surface as fine silk that has been dipped in water. As a consequence catgut "runs" somewhat stiffly. The catgut thread, moreover, is a little rigid, and when tied forms a comparatively large and clumsy knot, which has on more than one occasion given way. In many intestinal operations it is felt that a suture of a somewhat more abiding nature than catgut is desirable.

General Details of an Operation for Suturing Intestine.—It would be out of place to enter into any details as to the circumstances in which suture of the intestine is called for. A mere outline of the matter will suffice. The case may be imagined to be one of penetrating wound or of gunshot injury. The already existing wound is enlarged, or the abdomen is opened in the median line. The damaged coil is at once drawn forward into the wound, and is so held there by an assistant that no more of the intestinal contents can escape. If there be reason to believe that there are other wounds of the bowel, a careful and detailed examination of the whole length of the intestine must be made. Any wounded loop which may be discovered is brought into the parietal incision.

The breaches in the gut having been for the time secured, the next care should be to flush out thoroughly and cleanse the peritoneal cavity of every trace of extravasated matter. After this has been done, the treatment of the gut may be commenced.

The wounded loop is drawn out of the parietal wound, and is laid upon a fine sponge. The opening into the belly around the protruding loop is carefully plugged with gauze. The gut is held above and below the seat of the wound by the fingers of an assistant. The isolated segment is emptied of its contents, if necessary, and is, in any case, most thoroughly cleansed. The sutures are applied, and the gut is returned into the abdomen.

If the gut be extensively damaged, an artificial anus may be established, which should be closed at a later period.

Before establishing such an artificial opening, a segment of the damaged bowel may be resected, should the circumstances call for such a measure.

When there has been much extravasation into the peritoneal cavity, a gauze drain may be introduced before the parietal wound is sutured. It is very seldom needed.

Use of Omental Grafts after Suture of the Intestine.—After uniting the bowel by suture, Dr. Senn, in certain of his experiments, fixed a flap of the omentum over the seam left by the enteroraphy. These flaps soon became adherent, and proved an additional safeguard against perforation during the process of repair. The free or distal end of the flap was fixed in position by sutures; the proximal end remained connected with the omentum.

An obvious objection to this procedure in surgical practice is based upon the possibility of the attached omentum forming a band or bridge beneath which a loop of gut may be strangulated.

To meet this objection Dr. Senn cut off portions of the omentum in the form of isolated grafts, and fixed them by stitches around the bowel at the suture line.

The grafts used were from one and a half to two inches in width, and were of sufficient length to completely encircle the bowel.

The experiments were carried out upon dogs.

In all instances the grafts retained their vitality, and in a few hours became adherent in their new positions. The intestinal peritoneum was lightly searified before the graft was fixed in place.

CHAPTER VI.

RESECTION OF THE INTESTINE.

UNDER this title are included operations which concern themselves with the removal of comparatively small portions of either the small or the large intestine.

Excision when applied to the lesser bowel is termed enterectomy, and when carried out in the colon, colectomy.

Indications.—Most of these operations have concerned the lesser bowel, and have been performed to remove gangrenous parts in strangulated hernia, or to restore the canal after a faecal fistula has been produced. Enterectomy has also been performed for the relief of strictures of the bowel, both simple and epitheliomatous, for occlusion due to adhesions and certain neoplasms, for the relief of irreducible intussusceptions, and in certain examples of extensive injury, as after gunshot wounds.

The greater number of the cases of colectomy have been performed to effect the removal of a malignant growth, or to restore the bowel after an artificial anus.

History.—Accounts of the excision of portions of gangrenous bowel in hernia are to be found among the earlier annals of surgery. The operations were a little uncouthly performed, but were attended with some success.

In 1727 Ramdohr successfully removed two feet of gangrenous bowel from a hernia. (*See paper by Dr. Ill, New York Med. Rec., Sept. 22nd, 1883.*)

In 1732 Arnaud excised from a rupture the cæcum, with some part of the colon and ileum. The patient, a man aged sixty, recovered (“*Dissertation on Hernias*,” pt. 2, obs. xvii.).

Reybard in 1843 removed a carcinomatous growth of the sigmoid flexure, together with three inches of the gut. The patient survived the operation, and died of recurrence in twelve months (*Bull. Acad. de Méd., t. ix., page 1033*).

Within the last thirty years resections of portions of both the large and the small intestine have been carried out with a steadily increasing frequency.

McArdle (*Dublin Journal of Med. Sciences*, 1888, pages 1—123) has collected seventy-six examples of excision in gangrenous hernia. Kendal Franks (*Med.-Chir. Trans.*, vol. lxxii., page 224) has framed a table of fifty-one cases of excision of the colon for cancer.

Billroth reports (*Brit. Med. Journ.*, August 16, 1890, page 407) that he has himself performed 140 resection operations upon the stomach and the intestines.

Reichel as long ago as 1883 brought together 121 cases of gut resection for various conditions (*Deutsche Zeits. für Chir.*, 1883, page 230).

Mr. Croft's very admirable paper on rupture of the small intestine (*Clin. Soc. Trans.*, vol. xxiii.) includes a collection of fourteen cases of abdominal section for rupture of the small intestine without wound. In five instances excision was performed.

Of individual cases, one of the most remarkable is that of Koeberlé's. This surgeon removed over six feet of the small intestine from an adult suffering from multiple simple stricture. The operation was successful (*Bull. et Mém. de la Soc. de Chir. de Paris*, 1881, page 99).

I have dealt further with the subject of resection of the intestine elsewhere ("Intestinal Obstruction," London, 1899, page 528 *et seq.*).

The details of the operation will be considered under the following headings:—

1. Enterectomy with circular suturing of the divided ends.
2. Enterectomy with the aid of Murphy's button.
3. Enterectomy with the establishment of an artificial anus.
4. Methods of uniting segments of intestine of unequal size.
5. Colectomy.

I. ENTERECTOMY WITH CIRCULAR SUTURING OF THE DIVIDED ENDS.

1. The abdomen having been opened, the first step is to isolate the loop of intestine to be excised. This loop should be drawn well out of the parietal wound. Any adhesions which

prevent it from being well exposed and isolated must be divided.

If any extravasation has taken place into the abdominal cavity, it should be dealt with before the resection is commenced.

The operator must, moreover, be prepared for the absolute necessity of abandoning the excision altogether.

The disease or gangrene may be found to be too extensive, or the bowel may be so bound down that it would be impossible to isolate it sufficiently to enable a resection to be performed, or the amount of extravasated matter found in the peritoneal cavity may be such that the thorough cleansing of the serous

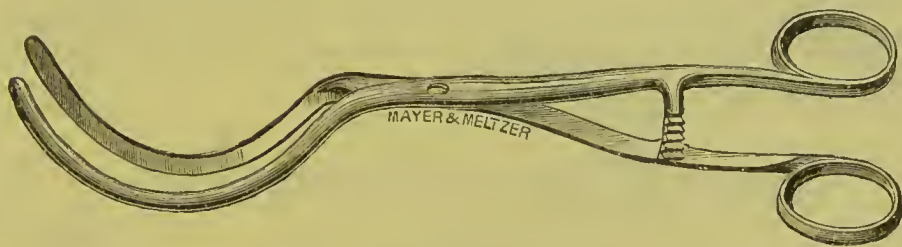


Fig. 377.—SIR THOMAS SMITH'S INTESTINAL CLAMP FORCEPS.

These preceded and are identical in principle with Doyen's Clamp. It is unnecessary to cover the metal blades with rubber.

space and the rapid establishment of an artificial anus will be obviously the right course to adopt.

Not only must the loop to be dealt with be well exposed, but healthy bowel both above and below the seat of disease must be brought into view.

The mesentery of the part to be resected should be also examined.

In cases of malignant disease it is needless to say that no resection operation should be entertained in cases in which the disease is other than very clearly limited, or in instances in which the mesenteric glands are found to be involved.

The part to be resected is placed upon a flat sponge, and the whole wound through which the intestine has been drawn is well and carefully packed all round with gauze or sponges. It should be impossible for any intestinal matter to find its way into the peritoneal cavity.

If the parietal wound has been very large, it may be desirable

that it should be closed in part by sutures before the resection is commenced.

2. The bowel must be occluded above and below the resection area. If sponges have been well packed all around the coil, this precaution may sometimes, and in some special cases, be dispensed with.

Many clamps have been devised for the present purpose. No instrument, however, is so efficient as the fingers of an intelligent assistant. The holding of the gut by an assistant, however, is apt to involve two difficulties. In the first place, his hands may come very much in the surgeon's way; and in the second place, it is scarcely possible to retain a proper and equable hold of the gut during the long space of time involved



Fig. 378.—MAKINS'S INTESTINAL CLAMP.

by the operation. Still, it must be remembered that no clamp is so good as an assistant's fingers.

Of the various clamps devised, that introduced by Mr. Makins is useful (*St. Thomas's Hosp. Reports*, 1884, page 81) (Fig. 378). The blades are covered with indiarubber tubing, and are long enough to compress the whole width of the bowel. They are simple, and are easily applied and removed. Another useful clamp is that known by Doyen's or Hartmann's name, though it is practically identical with that introduced previously by Sir T. Smith (Fig. 379). Other forms of clamps suitable for the intestine are figured in the chapter on Excision of the Pylorus.

Some surgeons ligature the bowel lightly above and below, making use of a cord made of gauze, which is passed through a hole in the mesentery. Dr. Senn, in experiments upon animals, was most satisfied with ligatures made of indiarubber bands. The bands are about one-eighth of an inch wide, and are applied by perforating the mesentery at a point free from large visible vessels, and are then tied in a loop with sufficient firmness to obstruct the lumen of the bowel.

A simple clamp or the fingers of an assistant are, however, to be preferred to any form of ligature. The ligature not only exercises an undue amount of compression and involves an injury to the mesentery, but it throws the cut margin of the bowel out of line, and in the case of a dilated bowel is apt to throw it into folds.

Dr. Maunsell (Inter-colonial Medical Congress, 1889) adopts the following simple method:—A flat piece of sponge is placed over the bowel, and the two ends of the sponge, together with the inter-

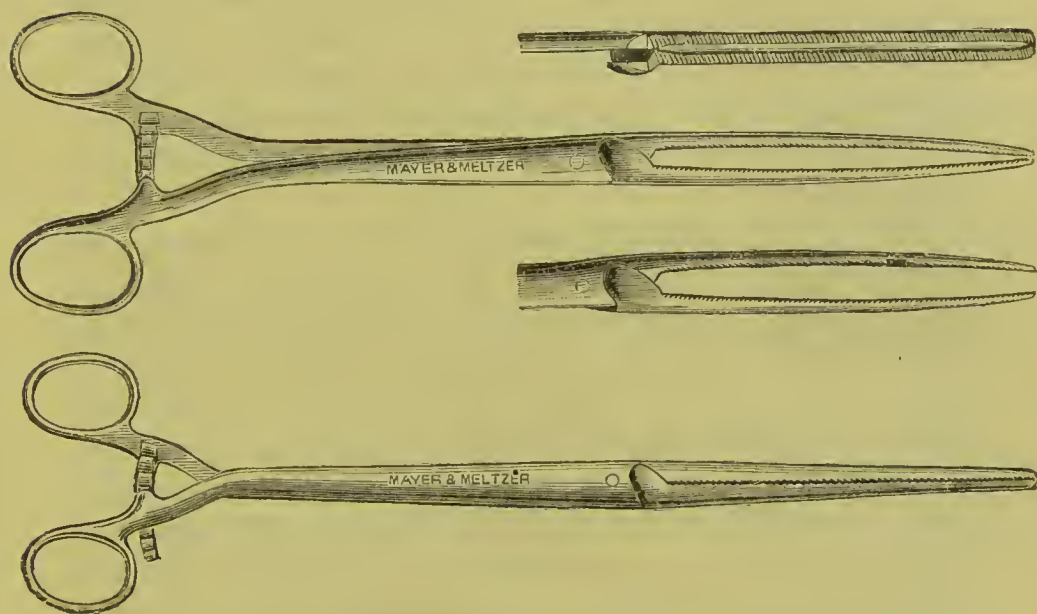


Fig. 379.—CLAMPS FOR GASTRO-INTESTINAL OPERATIONS (Hartmann's or Doyen's pattern). The Clamps are made in two halves, which take asunder for aseptic purposes. The degree of pressure on the intestine can be exactly regulated by the catch close to the handle. The lower figure shows the clamp completely closed.

vening mesentery, are transfixed with the shaft of a large safety-pin. The body of the pin lies over the sponge. By closing the pin the bowel is clamped.

In adjusting clamps (should these instruments be used) the upper clamp will be applied first. The segment of bowel to be excised will then be gently emptied by passing the fingers along it, and the lower clamp will be fixed in position. Little matter should therefore escape from the isolated segment during the division of the coats of the bowel. Before applying the sutures, care must be taken that the bowel above the resection area is not greatly distended. If it be so, the distension must be relieved, as much gas and faecal matter being allowed

to escape as will find an exit. This is best effected by making an opening in the centre of the loop to be excised, and allowing the intestinal contents to escape into a gutter of thin indiarubber tissue which has been already prepared and put in position. This answers better than the method of loosening the upper clamp after the bowel has been excised.

3. The portion of diseased bowel is now excised. This is effected with blunt-pointed seissors. The cut must be made about three-fourths of an inch beyond the margin of the clamp. If it be much nearer, it will be found that the clamp interferes with the movement of the needles during the passage of Lembert's suture.

The bowel should be cut straight across, *i.e.* at right angles to its long axis. After such a section, it will be noticed that the divided coats retract a little more on the free than on the attached border of the bowel, and as a result the incision lines tend to diverge a little and to become oblique. It has been advised by some that the bowel be divided by two oblique and diverging incisions, in such a way that more of the intestine is cut away upon the free than upon the mesenteric side. Experiment will show that there is little to recommend this method, and that it involves a less complete restoration of the natural curve of the intestinal coil.

The seissors cut their way from the free border towards the mesentery; on approaching the mesentery care must be taken to save as much of that membrane as possible.

The segment of bowel to be removed may be almost—as it were—enucleated. The mesentery may then be divided as close to the wall of the bowel as is possible.

An account has already been given of the interspace which extends along the whole length of the mesenteric attachment (page 288). The seissors will open this interspace, and will follow it, dividing the mesentery close to the bowel.

Another—and in most instances a better—method of treating the mesentery consists in excising a triangular portion of the membrane together with the gut to be removed. The base of the triangle will be at the intestine, but will be narrower than the length of bowel removed. By allowing the mesentery

to overlap the divided ends, as it were, the vascular supply of those segments is the less interfered with. The margins of the wound in the mesentery are then carefully brought together by a continuous suture. This measure brings about the neatest adjustment of the parts, and is most efficient in preventing that kinking of the suture line which is so apt to occur after resection operations. In cases of malignant disease it is an advantage to remove the mesentery which contains the lymphatics issuing from the growth. It is insisted upon by some that it involves, however, a greater amount of interference with the vascular supply of the divided ends of the bowel than does the method of cutting the mesentery close to the intestine; but it cannot be said that this point has yet been proved.

4. The divided ends of the bowel are now thoroughly well cleansed, and all soiled sponges are removed and replaced by fresh ones.

The mucous membrane may be found to protrude considerably, and to appear to interfere with the proper adjustment of the sutures. On no account, however, should any portion of this membrane be pared away.

The sutures may now be applied. If it is intended to introduce a double row, then the surgeon proceeds at once to unite the margins of the divided mucous membrane.

In an operation like the present, where time is usually a matter of considerable importance, the inner row of sutures may be dispensed with, or may at least be replaced by a continuous suture, which can be rapidly introduced.

The surface sutures will be applied according to Lembert's method, and in the manner already described (page 299).

It may be once more pointed out that the weak part of the suture line will be at the mesenteric border. It is at the line of the attachment of this membrane that the first stitches are applied. Use must be made of any peritoneum which has been saved from the mesentery, and sufficient must be found to serve as a covering for the bare portion of the bowel. Not only must the muscular coats be well brought together at this

part, but inturnd flaps of peritoneum covering that coat must also be brought into direct and close contact.

After the mesenteric border has been dealt with, it is most convenient to turn next to the free or opposite border of the intestine, and to insert three or four sutures there.

The surgeon may then introduce a batch of three or four sutures upon the lateral parts of the bowel, at points on either side, midway between the first two sets of sutures. Finally, the gaps between the four isolated batches of sutures are filled up, and the union of the divided ends is completed.

The clamps are now removed.

The surgeon next turns to the mesentery. If a triangular portion has been removed, the margins of the gap are brought together by several points of suture—or, better still, by a continuous suture.

If the mesentery has been divided close to the bowels there will be a large redundant fold to be dealt with. The cut edges of this fold may be united by a continuous suture. This, however, must not be allowed to suffice. To prevent kinking, to prevent a pouch from being formed, and to give to the suture line the fullest degree of support, the base of this fold of mesentery must be transfixed by a series of sutures, and the two layers of serous membrane in this situation be brought into close contact.

It will be obvious that in the great majority of instances, and notably in cases of malignant disease, this large redundant fold should be removed; or, in other words, that a triangular piece should be cut out of the mesentery together with the bowel.

5. The bowel is well cleansed, the sponges that have held the coil in place are removed, and the sutured loop is allowed to drop back into the abdomen. The abdominal wound is then closed; and, unless distinct reasons exist to the contrary, no drainage tube is introduced.

The application of the sutures is much aided by the use of a *bone bobbin*. This bobbin is especially of use in closing faecal fistula and the gap left by colotomy. In many of these cases the absolute division of the bowel into two parts may often

be avoided. If the bowel has been completely divided, the mucous membrane about the attached part of the gut is united. When about half the circumference has thus been sutured the bobbin may be introduced and kept in place by an assistant. The union of the divided mucous membrane is then completed; and finally the outer coats are united by means of a closely placed series of Lembert's sutures.

II.—ENTERECTOMY WITH MURPHY'S BUTTON.

The method of performing this has already been described (*see* page 304).

It should be noted that in resection of intestine, and still more in gastro-jejunostomy, the heavier part of the button should be inserted into the lower segment of the bowel. Care should be taken to press the two halves together with just sufficient force, and not to rotate or twist the segments of bowel in bringing them together. It is advisable to insert a few Lembert's sutures, especially towards the mesenteric attachment. Any redundant mucous membrane should be cut off before bringing the two halves of the button together. The button is usually passed *per rectum* at the end of two to three weeks if the patient does well.

There is no doubt that many cases of resection of intestine, whether performed with Murphy's button or by suturing, prove fatal owing to excess of caution in the actual excision. It is essential to success that the union should be made in healthy intestine, and not in that already damaged by inflammation. One or two feet of small intestine may safely be removed if necessary, and cases have recovered after excision of as much as nine feet. It must, however, be very rare for more than twelve or eighteen inches to require excision. With regard to gangrenous gut in a strangulated hernia, the rule should be to excise some inches on either side of the strangulated loop. For this and other reasons it is best to perform the operation through a median abdominal wound, and not through that made to expose the hernia.

III.—ENTERECTOMY WITH THE ESTABLISHMENT OF AN ARTIFICIAL ANUS.

The early steps of the operation are precisely the same as in the procedure just described.

The removal of a triangular piece of the mesentery facilitates the subsequent operation for the closure of the artificial anus. The gap left in the mesentery should be united by suture, as already described.

After the excision has been carried out, the wound in the parietes is so far closed as to leave only a gap through which the divided ends of the gut project. The two sections of bowel—still clamped—should be brought together by their mesenteric borders, and are united by a few points of suture. If time and the condition of the patient allow, the union of the two ends may be carried a little to either side of the mesenteric border. The mucous membrane over the uniting isthmus should be brought together by a simple continuous suture. This partial union of the gut greatly facilitates the operation for the subsequent closure of the fæcal fistula.

The lower end of the divided bowel is now rapidly united to the parietes. The margin of the bowel is secured all round to the margin of the parietal wound. The serous covering of the intestine must be brought into contact with the serous lining of the abdominal wall. The sutures can be most conveniently passed by means of a large curved Hagedorn's needle. The suture material which should be used in these cases is silkworm gut, which is peculiarly well adapted for the purpose. The needle must first transfix the skin, then the tissues of the parietes, then the parietal peritoneum, then the whole thickness of the wall of the intestine. If the needle be passed in the opposite direction—*i.e.* from mucous membrane to skin—the suture may carry intestinal matters with it into the depths of the wound. Each needle is probably soiled in the using, and therefore no needle and thread should be used for more than one suture. It will suffice if these sutures are about half an inch apart. The mucous membrane is finally attached to the skin in the gaps between the main sutures.

The main sutures may be passed before the clamp is removed, and may be drawn tight and secured when the clamp is withdrawn.

The upper end of the bowel is dealt with in the same way. Every preparation must be made for a rush of fæcal matter as soon as the upper clamp is removed. The main sutures will be in place before the clamp is withdrawn. A plug of wool in the lumen of the gut will very often serve to keep the wound dry. The intestinal contents may be received upon a layer of oiled lint, which is frequently changed. Beneath it the wound may be covered by a layer of iodoform.

This method of operating is commented upon in a subsequent section (page 326).

IV.—METHODS OF UNITING SEGMENTS OF INTESTINE OF UNEQUAL SIZE.

The bowel above the segment resected may be much dilated, while the tube below is much contracted. In such a case the two parts to be united may be brought to more nearly the same size if the distension of the upper part of the bowel be relieved by allowing its contents to escape. Moreover, after the excision, and before the sutures are applied, the lower clamp may be loosened, and the contracted bowel gently stretched to the necessary size with the fingers, after which the clamp may be reapplied.

In actual practice, however, these measures are usually not called for. If the bowel above the part to be removed be greatly dilated, and the bowel below be greatly contracted, then there must have been a severe grade of intestinal obstruction, and in such a condition the enterectomy should be concluded by establishing an artificial anus.

When, however, the cæcum has been excised, and the ileum has to be united to the colon, one or other of the following measures may be adopted :—

1. **Wehr's Method.**—The end of the narrower part of the bowel is not divided transversely, but is cut obliquely. The obliquity must be such that the oblong opening which results

shall correspond to the lumen of the other end of the bowel. This unequal division of the intestine must always be made at the expense of the convex or free margin of the gut.

2. **Billroth's Method.**—This is known as lateral implantation. Assuming that the cæcum has been excised, the end of the colon is closed by sutures. This is effected by invaginating the free margins of the divided gut, so that the serous coats are brought into close contact. The parts are united by sutures, preferably by a double row.

A slit is now made in the wall of the closed colon. This slit is vertical—*i.e.* in the long axis of the colon—is placed upon that margin of the gut which is opposite to the attachment of the mesocolon, and is situated about two inches from the closed end. The size of the slit will correspond to the size of the divided end of the ileum.

The end of the ileum is implanted in the slit, and is secured there by very careful suturing.

V.—COLECTOMY.

The operation for resecting portions of the colon differs in no essential particular from that applied to the small intestine.

After the diseased segment has been removed, the two divided ends of the intestine may be brought together and united by sutures, or any attempt at immediate union may be abandoned, and an artificial anus be established. In colectomy the latter procedure is more frequently carried out than is the case when the small intestine is dealt with.

An artificial anus may be established as a temporary measure, and may be followed by an attempt to close the opening at a later period by a second operation. In such a case the two ends of the divided colon are brought close together, and may even be united partially by a few sutures applied upon the deep or attached aspect of the gut.

If, on the other hand, it be intended that the artificial anus should be permanent, then it is well to close the opening in the distal segment of the bowel. This especially applies to resections carried out low down in the colon.

In closing the distal end it is well to turn in the edges a little, and to bring the serous coats of the bowel together so far as is possible.

The great majority of cases in which colectomy has been performed have been cases of malignant stricture of the bowel.

Mr. Kendal Franks (*Royal Med.-Chir. Trans.*, 1889) has collected fifty-one examples of this operation. The amount of intestine removed has varied from two to twelve or more inches. In one or two instances the whole cæcum has been excised, together with portions of the ascending colon and ileum.

In one case I excised the whole of the descending colon, sigmoid flexure, rectum, and anus. The patient made a good recovery. (See "Intestinal Obstruction," London, 1899, page 256.)

The best position for the incision in the parietes offers some difficulties. The most practical rule is that which would direct the incision to be made immediately over the tumour when a tumour exists.

In any case of doubt a small exploratory incision should be made in the median line, and this may be followed if necessary by a second incision directly over the seat of the disease.

Very little can be done through the median line. The transverse colon can be dealt with through an incision so placed; but with regard to other segments of the colon much depends upon the mobility of the diseased part and upon anatomical conditions. The summit of the sigmoid or omega loop may be excised possibly through a median incision. It is conceivable also that under certain conditions the cæcum may be resected through a like incision. The circumstances, however, must be exceptional; while for the treatment of the ascending and descending portions of the colon the median wound is of no avail.

In every instance it is desirable that the diseased bowel should be reached by the shortest and most direct route.

Portions of the ascending and descending colon have been excised through the loin, through an incision identical with that used in lumbar colotomy. Sufficient room, however, is scarcely to be obtained through such a wound, the surgeon's

movements are hampered by the restricted space in which he must manipulate, and the freeing of the bowel above and below the seat of the disease cannot be so efficiently carried out.

The details of the actual operation call for no especial remark, and the account above given of enterectomy will apply to the resection when performed upon the large intestine. The mesocolon, when it exists as a complete fold, is dealt with in the same manner as the mesentery.

The *bone bobbin* will be found to be of much use in the suturing of the large intestine after resection. *Murphy's button* is also of great use in dealing with the colon, as it is readily and certainly discharged. It is in connection with the colon, indeed, that Murphy's button will be found to be the most useful.

Comment upon Resection Operations.—The operative measures above described are serious, and have been attended in the past with a high mortality. With improvement in the technique of the operation, and with an increased knowledge of the best means of managing the bowel, the death-rate has been considerably modified.

The main point which needs consideration is the question as to which is the better method of performing resection—the method which concludes by circular suture of the divided ends of the bowel, or that which leads to the establishment of an artificial anus.

It is obvious that the former of these two methods is the more complete, and is, from a theoretical point of view, the more perfect and satisfactory. The diseased portion of the bowel is removed, the continuity of the canal is restored by suturing, and the abdominal cavity is closed.

It will be evident, however, that this method of performing resection involves a considerable expenditure of time, and that, to be surely successful, it requires all those conditions which contribute to the success of any extensive plastic operation. The general state of the patient should be favourable, and the local condition should be good.

Enterectomy, followed by circular suturing of the bowel, is a plastic operation in which perfect and immediate primary

healing is essential; and such healing can scarcely be looked for when the patient is *in extremis* at the time of the operation, when the bowel is suffering from long-abiding distension, or when the peritoneal cavity is the seat of fæcal extravasation.

Nevertheless, in such a grave condition as gangrene of gut in a strangulated hernia, primary resection offers the best prospect of recovery. The mortality is, of course, high.

Enterectomy, followed by circular suturing of the divided ends of the bowel, may be especially advised under such conditions as the following:—

1. Cases of injury (*e.g.* gunshot wound and stab) in which the whole of the damaged part can be readily excised, in which the injury is recent, and in which the condition of the patient is good.

2. Cases of growth involving the intestine, in which no marked degree of intestinal obstruction has been produced, and in which the general and local conditions are favourable.

3. Cases of resection involving the jejunum high up. The high mortality attending fistulæ in the upper part of the jejunum is well known.

In all these cases the state of the patient must be such as to enable him to withstand a long and tedious operation, and the local conditions must be such as would be required for the efficient performance of a plastic operation in other parts of the body.

In instances in which obstruction of the bowel exists a temporary fæcal fistula should be established.

The lives of such patients are threatened by reason of the obstruction, and the artificial opening gives immediate and entire relief.

If the divided ends be united by suture directly after the resection, the distension to a great extent remains, the obstruction is but imperfectly relieved, since the gut at the suture line remains paralysed.

Such patients are, as a rule, already in a position of great danger when the operation is performed. They are not in a condition which would enable them to undergo a long and elaborate operation. The state of the intestinal wall is not

such as would encourage sound and rapid healing, and the over-distended condition of the tube lends itself to the production of leakage at the suture line.

In colectomy, the objection to the formation of a temporary artificial anus is less obvious. At the same time, the patient may be better able to submit to a procedure which involves so great an expenditure of time as does the suturing of divided bowel. The colic cases demanding operation are seldom so acute as the enteric.

One fact must not be forgotten, which is that an artificial anus involving the large intestine is—other things being equal—less easy to close by a subsequent operation than is a like fistula in the lesser bowel.

After-treatment.—The treatment of the patient after one of these operations is conducted upon the same general lines that are observed after all serious abdominal operations.

The patient must lie absolutely still upon the back, and must turn neither to the right side nor the left.

The knees may be bent over a large pillow.

The bandage around the abdomen should not be too tight.

The diet must at first be reduced to starvation limits. The food taken for the first week should be small in bulk, and of such a kind as to leave little *débris* in the alimentary canal. Milk in large amount is not to be advised. Ice is better avoided; it often appears to induce intestinal pain.

Nutrient enemata may be of value, and thirst may be quenched by rectal injections of warm water.

Morphia will probably have to be administered. The less given the better; but it must be sufficient to arrest intestinal movement. In some patients morphia appears to excite peristaltic movement, and after an injection of the drug a rumbling of the bowels takes place, and coils that were previously collapsed become distended. Distension of the bowel is relieved by hypodermic injections of strychnia (gr. $\frac{1}{60}$).

Considerable relief usually attends the occasional introduction of the rectum tube.

The first action of the bowels should be on the fourth or fifth day.

Results of Resection Operations.—Dr. McCosh (*New York Medical Journal*, March 16, 1889) has collected 115 cases of resection of gangrenous intestine in strangulated hernia. In every instance the bowel was united at once by sutures. Fifty-seven died, and fifty-seven recovered (one was doubtful).

Reichel, in 1883, collected 121 examples of resection of the bowel for various causes. Out of this number fifty-eight died, fifty-eight are described as cured, and five recovered with a fæcal fistula (*Deutsche Zeitsch. f. Chir.*, 1883, page 230).

Resection of the small intestine for conditions giving rise to obstruction gave a mortality of 75 per cent.

Mr. Makins (*St. Thomas's Hosp. Reports*, 1884, page 81) has collected thirty-nine cases of resection for artificial anus. Of these fifteen died, three were left unrelieved, and the remaining twenty-one were cured.

In Dr. Morton's tables of 234 cases of "Abdominal Section for Traumatism" (Chicago, 1890) will be found sixteen examples of resection of the bowel for gunshot wound or stab. Of these twelve died and four recovered.

Mr. Kendal Franks has collected fifty-one examples of colectomy for malignant disease (*Med.-Chir. Trans.*, 1889). The mortality was about 57 per cent., and it is noteworthy that this mortality is not influenced by the method adopted—*i.e.* it is the same when immediate suture was carried out as when an artificial anus was established. In recent years the mortality of these operations has been very greatly reduced.

CHAPTER VII.

INTESTINAL ANASTOMOSIS.

By intestinal anastomosis is understood the establishment of a permanent fistulous communication between the intestine above and the intestine below the seat of some more or less permanent obstruction.

The general procedure may be illustrated by an imaginary case of malignant stricture at the junction of the jejunum and ileum (Fig. 380).

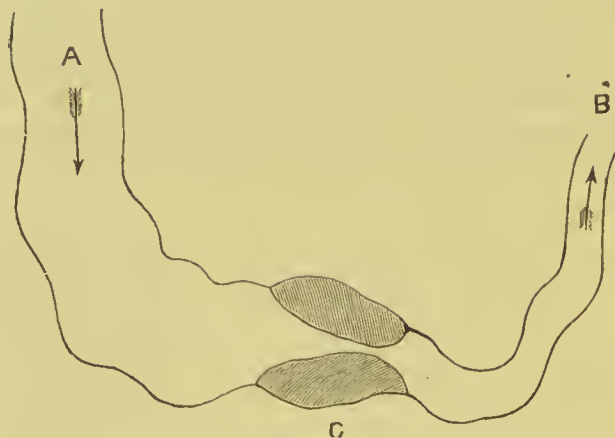


Fig. 380.—INTESTINAL ANASTOMOSIS.—DIAGRAM OF A SECTION OF INTESTINE.

A, Upper end of bowel; B, Lower end of bowel;
C, Malignant stricture.

Some obstruction has been produced. It is not considered advisable to excise the diseased segment. To overcome the occlusion, a loop of the lower part of the jejunum is brought to a loop of the upper ileum, and a permanent opening is established between the two.

The segment of bowel which is the seat of disease is thus excluded from the intestinal canal, and the intestinal stream is diverted into a new channel (Fig. 381).

The idea of establishing such a communication between the bowel on either side of an obstruction originated with Maisonneuve, who performed the operation in two cases. Both patients died, and the proposed measure fell into contempt.

The subject was revived in 1863 by Hacken, who carried out some experiments upon dogs. The operation, however, still remained in obscurity until it was revived by Dr. Senn, with whom must rest the credit of bringing intestinal anastomosis into the area of practical surgery.

Dr. Senn's chief communication was read at the Ninth International Medical Congress, held at Washington in 1887. A full account of his investigations will be found in a work on Intestinal Surgery, published in Chicago, 1889.

It is impossible to lay down any rule that will apply to all cases for which anastomosis may be indicated, and a short description of the methods of performing this operation must here suffice. They are for practical purposes three in number: (1) Simple suturing, (2) suturing combined with the use of Robson's bone bobbin, and (3) the use of Murphy's button.

1. Lateral Anastomosis by Suturing.—The two pieces of intestine which it is intended to join together are drawn out of the abdominal wound and supported by warm sterilised compresses or flat sponges. The contents are expelled by gentle pressure, and clamps applied above and below the site of anastomosis. Smith's or Hartmann's clamps will be found convenient (*see* Figs. 377, 379). The free surfaces of either piece of intestine are turned towards its end, and it is ascertained that they can be easily made to lie in contact, and that the clamps do not interfere with this. On the convex surface of each intestinal loop a continuous suture of fine silk, which traverses the coats down to the submucous layer, is passed, and tied at either end. The suture follows the axis of the intestine. Just in front of this the intestine

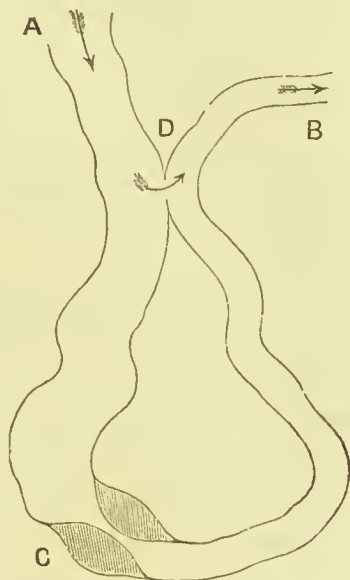


Fig. 381.—INTESTINAL ANASTOMOSIS.

A, Upper end of bowel; B, Lower end of bowel; C, Malignant stricture; D, Site of intestinal anastomosis.

is opened for from one and a half to two inches by a longitudinal incision made with a tenotomy knife or fine scalpel, and enlarged with fine scissors. Any fluid contents which have remained after clamping are wiped away. A continuous suture—fastened off at short intervals by knots—is then carried through the whole thickness of the circumference of the wound on either side. Finally, a continuous suture is passed through the outer coats of the intestine in front of the anastomotic opening. The clamps are removed as soon as possible, a few Lembert's stitches applied wherever it seems advisable, and the loops returned into the abdomen after gentle cleansing.

The method described differs hardly at all from that given in the section on Gastro-jejunostomy, and the reader may be referred to Figs. 408 and 409 for illustrations of the method of suturing.

2. Lateral Anastomosis with Mayo Robson's Bobbin.—

The only difference between this method and that just described is the following. After the posterior continuous suture has been made, the intestine opened, and the second suture carried half way round the opening, a decalcified bone bobbin is inserted, and the suturing continued in double row in front of the bobbin. The use of the latter is supposed to render the operation quicker and the suturing easier. As already noted, it is probable that the bone bobbin remains in place only a few hours, as the digestive juices rapidly cause it to be absorbed.

3. Lateral Anastomosis with Murphy's Button.—This is the quickest method but the least trustworthy, as it depends on a slough being formed, and involves a heavy metal body being left in the intestine, which may easily give trouble later. It is, however, so simple that it can be effected in a few minutes, and no detailed description is required beyond that already given (page 304).

Murphy's button is best suited, and is indeed well suited, for anastomosis involving the colon.

CHAPTER VIII.

ENTEROTOMY.

THE term enterotomy is applied to an operation which is carried out in cases of intestinal obstruction, and which consists in opening the distended bowel above the seat of the occlusion and allowing its contents to escape. This involves, of course, an abdominal section.

The procedure is sometimes known as "Nélaton's operation." It is assumed that the loop of bowel which is opened will belong to the small intestine, and in the majority of instances this proves to be the case. It has always been considered a feature of the operation that, after the abdomen has been opened, the most convenient distended coil which presents should be incised and a fæcal fistula forthwith established. It will be obvious that the term enterostomy would more precisely represent this operation than the term enterotomy, which would imply the mere cutting into the bowel, as in the removal of an impacted gall-stone.

The usage of many years has, however, established the position of the latter term, and the title enterostomy is employed by few.

Enterotomy for intestinal obstruction was first performed by Nélaton in 1840. He laid open the abdomen in the right inguinal region, and drew forth the first distended coil of intestine which presented.

This mode of treatment was, however, first suggested by Mannoury in 1819, but it was not carried into practice.

The Operation.—The abdomen is opened in the right iliac region—if Nélaton's method be strictly followed—by an incision parallel to and a little above the outer part of Poupart's ligament.

The incision is placed to the outer side of the epigastric artery, and its length must depend upon the thickness of the

parietes. One inch and a half to three inches will represent the extremes. French surgeons advise a cut of 7 cm. ($2\frac{3}{4}$ inches).

As soon as the abdomen is opened, the first distended coil of intestine that presents is seized and drawn into the wound. It will probably belong to the lower ileum.

The convex part of the distended knuckle is drawn well into the parietal wound, but the convex or free border should alone project.

The gut should not be twisted from its natural position—that is to say, the spontaneous direction it has assumed should be preserved.

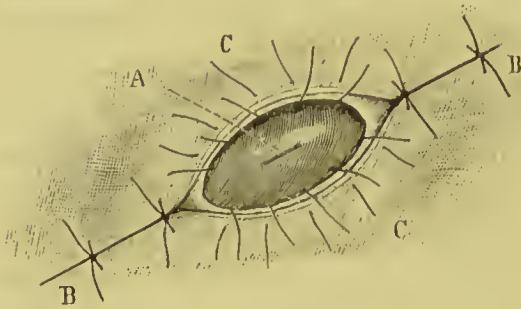


Fig. 382.—ENTEROTOMY.

A, Site of opening in bowel ; B, Sutures of parietal wound ; c, Sutures between the skin and the intestinal wall.

The wound in the abdominal parietes is now partly closed by means of silkworm-gut sutures which are introduced at the two extremities of the wound (Fig. 382, B B).

The bowel will occupy the centre of the wound, and a sufficient number of sutures (two probably on either side) must be introduced to fix the gut in place by the mere narrowing of the parietal incision.

The sutures must include all the tissues forming the parietes, together with the peritoneum.

The latter membrane should be brought as near to the cut margin of the skin as is possible.

It will be found that a curved Hagedorn's needle of large size is the most convenient for introducing the sutures.

The wall of the bowel is now rapidly stitched to the margin of the skin, which tightly surrounds it on all sides. Very fine silk, passed by means of a small curved needle held in a holder, is best adapted for this purpose. The stitches should involve the skin and the serous and muscular coats of the bowel (Fig. 382, c c). Care should be taken not to open the actual lumen of the gut with the needle. In cases of great

distension this is not easy. To save time, two operators may be engaged simultaneously upon this stage of the procedure.

A Paul's glass-tube (*see* Fig. 385) of small calibre is now taken up and the diameter mentally marked on the intestine. A purse-string suture is then made to circumscribe the area to be incised, both ends of the suture being left long. With a tenotome or fine scalpel the intestine is opened within the area, one edge of the wound held aside with fine forceps, and the tube introduced. The suture is now tied firmly round the groove in the tube; the latter is packed round with sterilised gauze, the distal end of the tube being provided with a long and thin rubber tube along which the contents as they escape can be conveyed into a receptacle containing a disinfectant. A large dressing of cotton-wool held in place by a bandage completes the operation. The glass tube comes away, as a rule, in five days. As the contents of the small intestines are comparatively fluid, the Paul's tube need not be so large as that employed in colotomy.

Supposing that a Paul's tube is not at hand, the following procedure is employed:—

The gut is opened by a small puncture. This should be effected with a scalpel, and not with a trocar.

Before the incision is made, the united parts of the parietal wound should be buried in iodoform, and the contents of the bowel should be allowed to escape upon a sheet of lint well covered with vaseline.

The small sutures that connect the gut wall with the skin are for the purpose of shutting off the peritoneal cavity. They would not suffice probably to hold the intestine safely in position.

To effect this latter object two lateral sutures of silkworm gut should be introduced, and should transfix the whole thickness of the intestinal wall except the actual mucous membrane, and take a firm hold of the integuments.

These sutures should be passed from without inwards, *i.e.* from the skin towards the gut. If passed in the opposite direction, they may carry faecal matter into the tissues.

The opening into the bowel should always be small, and should be upon the free or convex border.

The smaller the knuekle of intestine brought into the wound, and the smaller the fistula, the easier will be any subsequent operation for the elosure of the artificial opening.

The operation as above described can be carried out in a remarkably short space of time, and with the least possible amount of disturbance of important struetures.

After the gut has been ineised, there should be no squeezing of the abdomen, and no attempt to wash out the lumen of the bowel. The distended tube should be left to empty itself in its own way, and the less the process is interfered with the better.

A light dressing of absorbent wool, which may need to be changed at first every few minutes, is all that is needed.

The skin around the opening should be frequently dried, and then covered with vaseline.

Modifications of the Operation.—The incision may be as conveniently made in the median line below the umbilicus. The fingers are introduced, and an examination of the abdomen is made. It is possible that a band or some equally simple cause of obstruction may be discovered and remedied and the fæcal fistula be rendered unnecessary.

Such examination may enable the surgeon to select for his artificial opening a loop of intestine as near as is desirable to the seat of obstruction. The first loop which presents in the wound may be some distance from the place of occlusion.

Such a modification, although often advisable, is opposed to the chief principle of enterotomy, which is that relief be given to distended bowel in the simplest manner, with the least possible expenditure of time, and the least possible disturbance of parts. The opening has on many occasions been made in the left groin instead of in the right. In such a case it is probably the sigmoid flexure which is opened.

If time permit, it is well, before drawing a knuckle of gut into the parietal wound, to unite the peritoneum all round to the margin of the divided skin. When the bowel comes to be fixed in place, peritoneum is brought in contact with peritoneum, and a more speedy and certain sealing of the abdominal cavity is ensured.

Various methods of securing a loop of bowel in the parietal

wound will be found described in the section on Inguinal Colotomy, to which the reader is referred (page 350).

If the symptoms be not urgent, the operation may be performed *à deux temps*. The abdomen is opened and the bowel is fixed in place, but its lumen is in no way invaded. The part is dressed with iodoform. After an interval varying from a few hours to three days, the operation is completed by incising the gut and allowing its contents to escape.

In abdominal section for intestinal obstruction, in which the cavity has been widely opened up and determined attempts have been made to remove the cause of the obstruction, an enterotomy is often carried out as a last measure, all other attempts at relief having failed.

Value of the Operation.—Enterotomy is of undoubted value in urgent cases of intestinal obstruction when the patient is in immediate danger of death from the actual obstruction. The operation relieves the bowel rapidly and completely, and many lives have thus been saved. It does not profess to touch the cause of the disease, although there are not a few examples of acute intestinal obstruction which are permanently relieved by evacuating a distended bowel.

The great object in the treatment of acute intestinal obstruction is to empty the bowel. The patient is being poisoned by the retained contents of his own intestine, and the pressing need is to empty the gut at once of its noxious contents.

Dr. Curtis's analysis of sixty-two cases of enterotomy for *acute* intestinal obstruction gives the following results:—

Relieved by the operation	..	46 cases = 72 per cent.
Not relieved	.. .. .	6 „
Recovered	.. .. .	32 „ = 51·7 per cent.
Passage of fæces <i>per anum</i> resumed in	19 „	= 60 per cent. of the recoveries.
Died..	.. .. .	30 „ = 48·3 per cent.

In the fatal cases it is to be noted that the fistula has sometimes failed to relieve the obstruction (in three instances it was below the seat of it), and that gangrene of the gut subsequent to the operation is a frequent cause of death.

The whole matter is more fully dealt with in my work on “Intestinal Obstruction.”

CHAPTER IX.

COLOTOMY.

By colotomy is understood the operation of establishing an artificial anus in the colon. This may be either temporary or permanent. But for the fact that the term colotomy has become firmly engrafted in the language of medicine, the more precise term colostomy might be advised.

Colotomy is carried out for the relief of obstruction in the colon of various kinds, and is most frequently employed in cases of cancer of the rectum. It is performed also as a palliative measure in some examples of cancer of that part in which no obstruction exists.

Under such conditions it is used to divert the course of the fæces, and with a like object colotomy is performed in the treatment of recto-vesical fistula, and in intractable ulceration of the rectum and lower colon. It is performed also for imperforate anus in infants after the local operations have failed.

Lumbar colotomy implies the opening of the ascending or descending colon through the loin without wounding the peritoneum. This is known also as the extraperitoneal operation, as posterior colotomy, or the operation of Amussat and Callisen. The idea of the operation—which belongs to pre-antiseptic days—is to open the colon without wounding the peritoneum. The method is now obsolete.

Inguinal colotomy implies the opening of the sigmoid flexure, or the cæcum, through an incision in the iliac region which involves the peritoneal cavity. This is known as the intraperitoneal operation, as anterior colotomy, as Littre's operation, as laparo-colotomy, and as inguinal colotomy.

History of the Operation.—Colotomy was first proposed by Littre in 1710 (*Mém. de l'Acad. des Sc.*, Paris, vol. x., page 36). He advised the opening of the sigmoid flexure in the iliac region in certain cases of imperforate anus.

The method is said to have been first successfully practised by Dinet in 1793 (Sabatier's *Méd. Opér.*, vol. ii., page 336). In 1776 Pillore, of Rouen, opened the cæcum in the right iliac region through an incision which involved the peritoneum. The case was one of cancer of the rectum. (See *Brit. and For. Med. Review*, vol. xviii., page 452.)

The first iliac colotomies performed in England appear to have been carried out in 1821 by Freer and Pring (*Lond. Med. and Phys. Journ.*, 1821, page 9). The patients were adults, and the trouble was stricture of the rectum. Freer's patient died on the tenth day; Pring's patient recovered.

Lumbar colotomy was first advocated by Callisen, of Copenhagen, in 1817 (*Systema Chir. Hodiernæ*, t. xi., page 842, Hafniæ, 1817). He proposed to open the descending colon through a vertical incision in the loin.

¶Jean Zalema Amussat carried out lumbar colotomy with success in 1839 (*Mémoires*—three in number—published in Paris, 1839–43). He employed a transverse incision, and extended the operation to the ascending colon. Out of six patients upon whom he operated, five recovered.

Among the earliest operators in England by the lumbar method were Curling, Hilton, and Bryant. Mr. Bryant's first lumbar colotomy was performed in 1859, and he believes that this was the second operation of the kind performed in England—a colotomy by Hilton having been the first (Bryant, "Bradshaw Lecture," 1890, page 3).

Interest in the inguinal operation was revived in England by Mr. Reeves, and the value of the method has been demonstrated, and the details of the operation have been improved, by Mr. Allingham, Mr. Chavasse, and others.

The mortality attending colotomy has been in recent years very considerably improved, and the operation, once regarded as a desperate and uncertain procedure and a last resort, has come to be employed as a sure means of giving relief, and as a measure which may be carried out comparatively early in the progress of the diseases concerned.

Lumbar colotomy has been almost entirely abandoned in favour of the inguinal operation. Indeed, a colotomy in the loin has become a very rare operation.

Colotomy itself has been rendered very much less frequent by the introduction of short-circuiting of the bowel.

Anatomical Points.—The chief details in the anatomy of the colon which are of importance in connection with the operation of colotomy have been already alluded to.

In lumbar colotomy especial attention should be paid to



Fig. 383.—HORIZONTAL SECTION THROUGH THE BODY AT THE LEVEL OF THE UMBILICUS. (After Braune.)

- a*, Spine of the fourth lumbar vertebra; *b*, Disc between the third and fourth vertebrae; *c*, Umbilicus; *d*, Quadratus lumborum; *e*, Psoas; *f*, External oblique, with internal oblique and transversalis muscles beyond; *g*, Rectus; *h*, Descending colon; *i*, Transverse colon; *j*, Aorta; *k*, Inferior vena cava; *l*, Ureter.

the condition of the mesocolon upon the right and the left sides of the body (page 290).

The position of the ascending or descending colon in the loin may be approximately represented by a vertical line drawn upwards to the last rib from a point about half an inch posterior to the centre of the crest of the ilium. The centre of the crest will be indicated by a point midway between the anterior superior and posterior superior iliac spines.

LUMBAR COLOTOMY.

Instruments Required.—Scalpels; straight and curved scissors; dissecting, pressure, and artery forceps; broad rectangular retractors; Hagedorn's needles, of various sizes, and needle-holders; blunt hooks; sutures and ligatures.

Position.—The patient should lie upon the sound side and close to the edge of the table. A small hard pillow or sand-bag is placed under the opposite loin, so that the region to be operated upon may be brought well into view, and the space

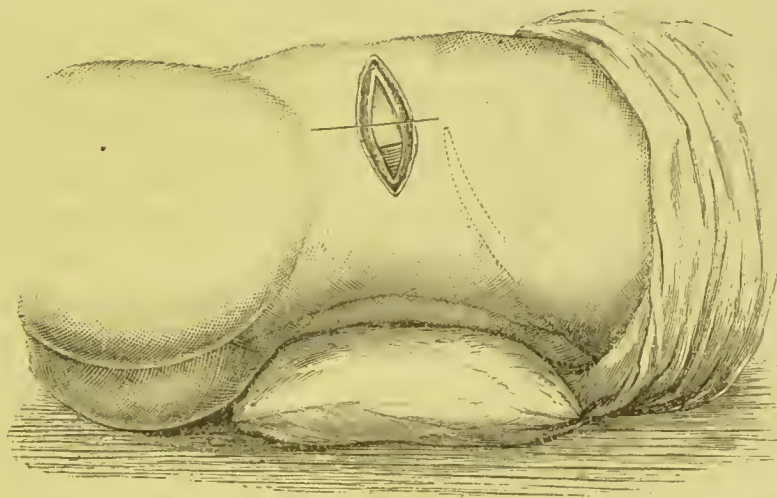


Fig. 384.—THE INCISION IN LUMBAR COLOTOMY. (The quadratus lumborum muscle is exposed.)

between the crest of the ilium and the last rib be extended to the utmost (Fig. 384). In very corpulent subjects, and in cases in which there is considerable distension of the abdomen, this pillow may be dispensed with. The surgeon stands upon the side to be operated upon; the chief assistant is facing him, and upon the opposite side of the table. He attends to the sponging, and assists in holding the gut when it has been secured. An assistant may stand upon either side of the operator, and may attend to the retraction of the wound.

Operation.—*First Stage.*—The incision should be from three to three and a half inches in length. It is placed obliquely, midway between the last rib and the iliac crest. Its centre should correspond to the centre of the line marking the site of the bowel (Fig. 384). It will be about parallel to the

last rib, or will follow a line drawn from the anterior superior spine to the angle between the twelfth rib and the mass of the erector spinæ muscle.

The length of the incision will be mainly influenced by the thickness of the tissues, and this for the most part will depend upon the degree of corpulency. The tendency is rather to make the incision too long.

After the skin and superficial structures have been divided, the external oblique and latissimus dorsi muscles will be exposed. The fibres of these muscles are in this situation vertical. They should be divided by a single clean cut through the whole length of the incision.

The layer of the internal oblique will next come into view. The fibres are found running somewhat obliquely upwards and forwards. This muscle is also cleanly divided through the whole length of the original wound. In the posterior part of the wound the fascia lumborum will probably come into view.

There are now exposed a few of the hindermost fibres of the transversalis muscle, which are nearly transverse in direction, and the fascia lumborum. If the incision has been made as described, the actual amount of muscle tissue exposed in the depths of the wound will be slight.

The muscle and the fascia are now divided to the full length of the wound. Before this division is made it will probably be noted that the twelfth dorsal nerve, accompanied by the abdominal branch of a lumbar artery, are crossing the area of the operation. It is as well to avoid cutting the little artery.

In the posterior part of the incision the clear anterior border of the quadratus lumborum will be seen (Fig. 384). The fibres of that muscle seldom, if ever, need to be divided. Broad rectangular retractors will be found very useful at this stage of the operation.

A little fat may now come into view, and be mistaken for the subperitoneal tissue. It is the fat beneath the transversalis fascia.

This fascia must be sought for and demonstrated, and cleanly divided to the full length of the wound. It is well to

commence the division close to the anterior border of the quadratus lumborum.

The subperitoneal fat is now reached, and the first stage of the operation is completed.

The structures above named must be cut cleanly and deliberately. The experience gained by many dissections in the dissecting-room will enable the operator to perform this stage of the operation very quickly. A good anatomist can, from a general view of the body, judge of the thickness of the tissues through which he will have to pass.

The student will find that the muscular layers are comparatively thin, and totally unlike the thick plates of muscle which are depicted in anatomical text-books.

No director is needed, and in no operation is that dangerous weapon more out of place.

The parts should not be divided with scissors. All that is needed are a scalpel and a pair of dissecting forceps.

The operator will seldom be delayed by the need of applying pressure forceps to a bleeding point.

The chief error in this stage of the operation is due to the ignoring of the transversalis fascia and the failure to completely divide that structure.

Second Stage.—The gut is now sought for. When great distension of the abdomen exists, the colon very frequently bulges at once into the wound as soon as the tissues around it have been freed by the finger.

Failing such an appearance, the forefinger is introduced into the subperitoneal tissue and the colon is sought for. The finger follows the anterior surface of the quadratus lumborum, and seeks for the angle which exists between this muscle and the psoas (Fig. 383).

It is towards this angle that the non-peritoneal surface of the colon faces in cases where no mesocolon exists. In seeking for this part the lower end of the kidney will be felt, and it must be remembered that the bowel lies on a plane anterior to it.

It is essential that the subperitoneal fat be well opened up with the examining finger or fingers. The exposure of the non-distended bowel is impossible unless this be done.

In corpulent subjects an immense thickness of tissue will have to be ploughed through before the colon is reached.

The bowel may perhaps be recognised in the depths of the wound by the thickness of its coats or by the presence of a scybalous mass. In such case it should be gently freed and drawn into the more superficial part of the wound for examination.

The surgeon must be convinced that his fingers are behind the peritoneum—which he is, indeed, separating from the posterior parietes—and that the subperitoneal fat has been fully opened up.

Assuming that the colon has not yet been discovered, the curved forefinger should be placed in the angle between the psoas and quadratus lumborum muscles, and the patient should then be rolled over almost upon the side operated upon. The bowel that falls into the finger cannot well be other than the colon. (*See Fig. 383.*)

Failing the rolling over of the body, the assistant who faces the surgeon may press upon the anterior abdominal parietes so as to force the intestines towards the loin.

The surest guide to the non-distended colon is the feeling which is communicated when its coats are picked up between the forefinger and the thumb.

The extent of the non-peritoneal surface of the colon will depend in part upon anatomical conditions, and in part upon the degree of distension of the gut. When the gut is not distended, this surface cannot be expected to exceed, and often not to equal, one inch.

The gut, when brought into view, may be identified by the thickness of its coats, by its non-peritoneal surface, and possibly by the existence of a longitudinal band.

The band which comes into view is that known as the posterior. The bands of the large intestine are well seen in the ascending colon, but are less clearly marked in the descending segment of gut, the longitudinal layer of muscle becoming more evenly spread over the colon as the rectum is approached. The colon can be recognised by many means, without wasting time over a search for the posterior longitudinal band.

The sacculi of the colon cannot be demonstrated, as a rule, through a lumbar colotomy wound. They are valueless as a means of identification.

The appendices epiploicæ can only be seen when the peritoneum has been opened, and when the colon has been drawn through the rent.

In the search for the bowel great service is rendered by good broad rectangular retractors and a good light.

When a distinct mesocolon exists, and the colon is empty, the peritoneal cavity must of necessity be opened up and a loop of the intestine drawn through.

If, however, the mesocolon can be identified—and on the left side a branch of the inferior mesenteric artery may indicate it—the separation of its two layers is not as a rule difficult.

If the peritoneum has been opened, it is of little use to waste time in attempting to sew up the rent, as advised by some. In the deep wounds which are inevitable in corpulent subjects the closure of the gap in the membrane may be almost impossible. The rent made will most probably be large and irregular, and may be internal to the bowel.

I have never seen harm arise from neglecting to close an accidental or deliberate rent in the peritoneum in this situation, and it is remarkable how little such an opening of the serous cavity affects the results of the operation.

Should distended coils of small intestine protrude through the laceration in the serous membrane, and make their way into the superficial wound, the closure of the rent becomes still less possible. It is advised in one text-book that the distended loops should be reduced and the rent in the peritoneum closed by sutures. How this marvellous manœuvre is to be effected the writer does not state, nor is it explained how the inflated coils are induced to remain quietly in position while the surgeon is sewing up the peritoneum, nor how they escape injury from the surgeon's needle.

Such protruding coils reduce themselves when the distension of the abdomen is relieved.

Third Stage.—The bowel is fixed in position and opened. If the colon do not come readily into the wound, or if there be

difficulty in retaining it, its walls should be seized in a vertical direction by long pressure forceps. No more of the coat of the bowel should be picked up in the forceps than is required to give a hold for the instrument. It is in the part so held that the future opening may be made.

It is needless to observe that the opening must be made in the non-peritoneal segment of the bowel, and therefore upon its posterior surface.

Gentle pressure exercised upon the front of the abdomen will help to keep the gut in position. The more completely the subperitoneal tissue has been opened up, the more easily can the bowel be brought into view. The bowel should be merely drawn to the level of the skin. It should not be dragged out as a loop or even as a knuckle.

By means of a large curved needle the two extremities of the parietal wound are now closed by sutures. Silkworm gut should be employed, and the needles should be passed very deeply, so as to include all the divided structures down to the fascia lumborum.

Probably two such deep sutures on either side of the centre of the wound will be sufficient.

They should all be passed before any are tied. When they are tied, the skin should very closely embrace the small dome of protruding bowel which, still held by the forceps, presents in the centre of the incision. The appearance presented will be nearly identical with that shown in Fig. 382, which illustrates the same stage in enterotomy.

As the edges of the wound, at its lateral extremities, are being brought together, the bowel should be drawn a little upon by means of the forceps, with the result that the skin and the bowel wall are brought into close contact.

By means of a small curved Hagedorn's needle, the skin is in the next place united all round to the intestine by many points of suture. The needle should only concern the skin on the one hand and the muscular coat of the bowel on the other. The lumen of the gut should on no account be penetrated. Fine silk may be used for this purpose.

If this be well done, it is quite impossible for any faecal

matter to find its way into the depths of the wound; and should there be a rent in the peritoneum, it will at least be efficiently shut off from communication with the surface.

The part is well dusted with iodoform. The hard pillow is removed, and the patient's body is a little inclined over to the affected side. A piece of lint well smeared with vaseline is at hand to form a surface over which the escaping fæcal matter may run.

Finally, the forceps are removed from the gut, and an opening is made into the bowel by means of a small scalpel. The opening is quite large enough if it will admit the point of the little finger. The amount of flatus and fæces that escapes varies remarkably.

By means of a curved Hagedorn's needle of medium size, or a curved needle in a handle, the final sutures are introduced. They concern the whole thickness of the coats of the bowel on the one hand, and the skin on the other. Silkworm gut should be the material employed.

The needle is introduced through the skin, and its point is made to appear in the interior of the bowel. A fresh needle and a fresh thread are employed for each suture. If the suture be passed in the opposite direction—*i.e.* from the mucous membrane to the skin—a fæcal seton is practically drawn through the tissues.

Silk should not be employed, as it favours the passage of intestinal fluid along its fibres by capillary attraction. Of all ligature materials, it is the one least well suited for the present purpose.

In securing the bowel, it is well to avoid too many stitches, too large needles, and too thick suture material. It is well also that the opening into the colon should be, at first at least, quite small.

Comment.—The only difficult part of the operation consists in the search for the colon, when that part of the bowel does not readily present. In the great majority of the cases the colon at once makes itself evident.

It is remarkable that on the right side the duodenum has been opened in mistake for the colon, and on the left side the

stomach. A hypertrophied and distended coil of small intestine has, with some better reason, been opened in the place of the large gut.

If the colon has been well freed from its connections in the depths of the wound, there is no need of any special instrument for drawing the gut forward towards the skin.

The surgeon should aim at making the smallest possible opening in the colon. It can, if need be, be enlarged later.

The transversalis fascia may readily be mistaken for the peritoneum, especially where the bowel appears to glide beneath it. The recognition of this fascia is a matter of primary importance.

The bulging peritoneum may be mistaken for the bowel. This error will not happen to one who is familiar with the feel of the colon when picked up between the finger and thumb.

It must be remembered that the bowel may be empty when exposed, and this even when a cancerous stricture of the rectum is known to exist.

A very fat loin introduces a difficulty in the operation. It must be met by a free incision, by a thorough division of each layer of tissue along the whole length of the original wound, and by the use of good retractors and a good light.

When the symptoms are not urgent, the operation may be carried out in two stages (*colotomy à deux temps*). The bowel is sought for, and is fixed to the skin by numerous superficial sutures precisely in the manner described. Care should be taken that no suture extends through the mucous lining of the bowel. The part is well dusted with iodoform, and after an interval of some hours, or some days, the operation is completed by opening the colon.

After-treatment.—The actual wound is dusted with iodoform, and all the skin around is well covered with lanoline. A large pad of absorbent wool is placed over the artificial opening, and retained by means of a many-tailed bandage.

So long as there is a copious escape of faecal matter, no bandage should be applied.

The pad of wool must be changed as often as it is soiled,

and the exclusive attention of one nurse may be occupied in keeping the patient always clean.

When the discharge is very free, a pad of loose "tenax," covered with a layer of wool, will be found to be more convenient.

The main feature in the nursing is that the part must be kept dry. The skin should not be *rubbed* clean, but should be cleansed by a stream of warm water, which is received in a kidney-shaped tray. This method involves no more trouble and no more time than the patting and rubbing process which is carried out with innumerable pledgets of cotton-wool.

After each washing, the skin is very gently dried, and is once more covered with lanoline.

If the wound were to need to be washed every fifteen minutes during the first day or so, it would certainly be better than to allow a freshly-united incision to remain for an hour or more poulticed with fæcal matter.

During the first few days the patient should keep very quiet, should lie upon the back, or, if the position be altered at all, should turn over towards the wounded side. The attachments of the gut will be dragged upon if the patient lie upon the sound side.

The discharge of fæcal matter from the bowel may be delayed for hours, or even for days.

The opening, as already stated, is at first very small; and if it suffice, well and good. If, however, hard scybalæ have to escape, then the opening must be in due course enlarged.

An apcrient given on the fourth or fifth day after the operation has often an excellent effect.

Prolapse of the gut at the artificial opening is, so far as my experience goes, but rarely met with. A preliminary small opening in the gut, primary healing, and the maintenance of a healthy condition of the mucous membrane, appear to be the main factors which assist in preventing this complication:

The skin around the artificial anus may become very raw and inflamed. This is especially apt to be the case when the fistula is established near to a malignant growth, as when the colon on the right side is opened.

In these circumstances a frequent washing-out of the bowel, and the most scrupulous attention to the cleanliness of the part, will effect much.

Properly-shaped pieces of lint soaked in oil may prevent some of the fæcal matter from running over the skin, but no contrivance that I have as yet seen has prevented it entirely.

The disturbing symptoms produced by the presence of fæcal matter in the colon below the artificial opening may be relieved by the systematic washing-out of that part of the bowel, and by the subsequent closure, if need be, of its upper extremity.

The diet in these cases should be spare and nourishing, and of such a kind as to leave the least possible residue in the intestine. The consumption of milk in considerable quantity appears to encourage the formation of scybalæ. A liberal amount of vegetable matter should be a feature in the diet.

After the wound has healed, and the recovery from the operation is complete, the patient may be furnished with a simple belt which will permit a pad of wool or some folds of linen to be held in place when the patient is moving about. The simpler the belt the better, and it must be so constructed as to be readily unfastened. The various plugs, cups, bags, and pessaries which have been devised for the use of patients after colotomy are, so far as I have seen, more or less useless: After a short trial they are usually abandoned for some simple arrangement of cloths or pads which the patients have themselves devised.

INGUINAL COLOTOMY:

This operation has been rendered easier and more simple of late years, and the introduction of Paul's tubes has made immediate opening of the bowel a safe proceeding. Inguinal colotomy has almost entirely supplanted the lumbar operation, and is the operation to be chosen whenever the large intestine requires to be opened, provided that the obstruction is below the upper part of the sigmoid flexure.

Instruments Required. — Scalpels and blunt-pointed bistoury; scissors; fine-pointed forceps; several Wells's forceps;

blunt hooks ; retractors ; straight and curved needles ; needle-holders ; silk sutures, etc. Sometimes a wooden, ivory, or glass rod is employed for fixing the intestinal loop outside the wound. A strip of gauze will serve the same purpose.

The Operation.—The chief points to be remembered are : (1) To make as short an incision through the muscular wall of the abdomen as possible ; (2) to open the highest part of the sigmoid flexure that can be drawn into the wound without undue tension ; (3) to ensure an efficient spur being made out of the posterior wall of intestine.

By these means fæces are prevented from passing on into the rectum, prolapse of the intestinal wall is to a great extent avoided, and a certain amount of control over the artificial anus is obtained.

The exact position of the wound is not of great importance. A convenient guide is a line drawn between the umbilicus and the anterior superior spine on the left side ; at a distance from the latter point of about one and a half inches a wound rather more than two inches long is made, crossing this line downwards and inwards. Or the incision may be placed parallel to the outer third of Poupart's ligament and from half to one inch above it.

The external oblique aponeurosis being divided to the extent of two inches, the internal oblique and transversalis are cut through to a less extent, dissociation of their fibres being also employed. It is convenient to catch each muscle as it is divided by Wells's forceps, which act as retractors. The transversalis fascia, subperitoneal fat, and peritoneum are then cut through. The forceps are then transferred to the cut edges of the peritoneum, and the surgeon proceeds to find the sigmoid flexure. It often happens that the first loop to present is small intestine. In this case it should be pushed inwards. The great omentum should be treated in the same way. The operator, working across the iliac fossa, recognises the sigmoid by its being bound to the former by its mesocolon, and draws the loop into the wound. Confirmation of its nature is obtained by seeing the longitudinal bands and appendices epiploicæ.

The loop must be drawn forwards into the wound, so that the whole circumference of the gut lies outside the peritoneum. This is nearly always practicable, unless the mesosigmoid be abnormally short. The loop should be followed upwards until the highest convenient part is secured, the rest being returned into the abdomen.

The next step is to fix the loop in position. This may be effected in one of two ways. The simpler consists in passing a wooden or ivory rod, three or four inches long, through the mesosigmoid from side to side; the rod then rests on the abdominal wall and prevents the intestine being retracted. Two stout steel needles, the ends of which are fixed in cork, will serve the same purpose (Watson Cheyne). Hartmann recommends a strip of iodoform gauze, which is passed through the mesentery. He states that he has used it in upwards of thirty cases with satisfactory results. One drawback to the use of gauze is the difficulty with which it is removed.

The other method, which is perhaps the better one, consists in passing a mattress suture of silk through the muscular edge on one side, then through the mesentery, the other muscular edge, and back again. The suture is then tied. Whichever method be employed, two sutures should be inserted to secure the sero-muscular coats of the bowel to the skin. Care should be taken to replace any piece of omentum that may protrude, and the stitches just mentioned will tend to the avoidance of this accident when the patient strains or vomits after coming round from the anæsthetic.

The surgeon now decides whether or not to open the intestine at once. (1) If there has been no distension of the abdomen before the operation, the opening may be deferred for three or four days. In that case soft sterile gauze is packed round and over the protruding loop, and a pad of cotton-wool kept in position outside this by a bandage or binder. A moderate dose of morphia or an opiate should be given the same evening if there is pain or restlessness. At the end of three or more days the intestine will adhere firmly to the wound and may be opened without giving an anæsthetic. The rod or gauze which supports the loop should be removed.

A tenotomy knife is useful for puncturing the coats of the bowel, the incision being enlarged to the requisite extent by narrow-bladed scissors. If redundant intestinal wall be cut away, the arteries bleed freely, and should be clamped with forceps or tied with silk. The intestine seems to project unduly for a time, but it settles down.

(2) If it be decided to complete the artificial anus whilst the patient is under the anæsthetic, a Paul's tube of suitable size should be inserted. On the convexity of the intestine a purse-string suture of silk is placed, circumscribing

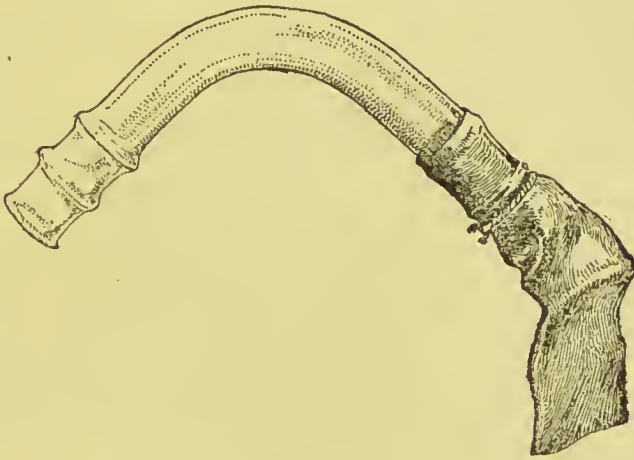


Fig. 385.—PAUL'S TUBE FOR COLOTOMY OR ENTEROTOMY (about half-size).

The tube is made in three sizes. The commencement of the rubber tube is shown tied to the glass one by a silk thread.

an area of, say, an inch in diameter. In this area a linear opening is made, the edges are held aside by fine-toothed forceps, and the glass tube is introduced. The tube is so placed that its lumen is directed upwards, and the silk suture is firmly knotted round the groove on the tube (*see* Fig. 385). A soft rubber tube, some few feet in length, may have already been fixed to the other end of the glass tube, through which the intestinal contents may pass into a covered jar containing a disinfectant. The rubber tube can be dispensed with. It tends to pull the glass tube out of place. In this way the wound can be kept absolutely clean and the neighbourhood of the patient free from odour until the tube comes away after a few days have elapsed. The

insertion of the glass tube, which should be large enough to allow faecal matter to pass along it, may be effected so quickly that no leakage occurs before the silk is tied. The tube is supported in position by a thick pad of gauze and wool around it; this dressing is held in place by a bandage. A cradle is used to keep off the weight of the bed-clothes, and the rubber tube may be conveniently attached to the side of the cradle and so carried out of the patient's bed.

Provided the tube does not get blocked, it may be left to come away by itself, which usually happens four or five days after its insertion.

Whether the opening has been immediate or deferred, and whether a Paul's tube be used or not, the result is the same in a week's time. Constant care is required to remove the escaping faecal matter, to prevent its becoming too fluid and irritating, and to keep the surrounding skin as clean as is possible under the circumstances. The diet should be regulated in the direction of procuring solid motions, and lanoline, thymol jelly, or hazeline cream used after each cleansing of the artificial anus. The lower end of the bowel may require to be washed out from time to time through a soft rubber tube, and, if necessary, small enemata can easily be given through the upper opening.

If the bowel has been brought well into the wound and fixed there by one of the methods described, and if the opening into it is made large enough, there will be little risk of the latter contracting subsequently to any serious extent. It is very different in the cases now to be referred to.

Modifications and Complications of the Operation.—*Scanty sigmoid mesocolon.* Now and then the sigmoid mesentery will be found to be very scanty, so that it is impossible to bring the loop well into the wound. The old method of multiple sutures, which is described on page 346, may then be employed. Two guide sutures are placed in the free surface of the bowel; these sutures only pass through the outer coats. The peritoneum may be united to the skin at four points of the wound, but this is by no means necessary. A number of silk sutures are then inserted through the edge of

the skin and muscle wound, and then through the outer coats of the intestine, one longitudinal muscular band being utilised for this purpose. Finally, after threading the guide sutures and fixing either end by their means to the upper and lower angles of the wound, the bowel is ready for the insertion of Paul's tube; or the opening may be deferred for some days. If the latter course be adopted, it is well to mark the point for the incision by a temporary loop of ligature passed through the outer coats; otherwise, with the altered appearance of the gut, some difficulty may be found in entering its lumen.

The tension on the mesosigmoid is occasionally so great that the stitches tear through. In one case I (J. H.) knew this occur twice; the third attempt at fixing the sigmoid succeeded, and a satisfactory artificial anus was obtained. Had the bowel been opened on the first occasion, the patient would undoubtedly have died of peritonitis. In such cases the colon should be fixed only to the peritoneum or muscles and not to the skin, whilst if this is impossible it is best to open the transverse colon in the middle line or even the cæcum by a fresh incision on the right side.

Prolapse of Great Omentum.—This troublesome accident is likely to occur if the operator dispenses with sutures and relies on the peg passed through the mesentery. When the patient strains, omentum or even small intestine is very apt, during the first twenty-four hours after the operation, to find its way into any chink left between the sigmoid and the wound edges. Hence additional sutures, besides the mesenteric ones, should invariably be employed, and, as stated, the division of the abdominal muscles should be as limited as possible.

What should be done if the sigmoid flexure is found to be empty and contracted?—Malignant stricture of the large intestine is by far the most common in the rectum and the sigmoid flexure; it may, however, occur in any part of the colon, nor is it possible always to decide its position until the abdomen is opened. In a case of obstruction in which the operator has made the incision for inguinal colotomy and then finds the sigmoid empty and contracted, he should on no account open this part of intestine. Through a fresh incision in the upper part

of the linea alba, he should explore for the site of obstruction. If it is found at the splenic flexure, an artificial anus should be made in the transverse colon; if in the ascending colon, the cæcum should be opened, etc. The methods are practically identical with left inguinal colotomy. In many of these cases, however, the difficulty can be well met by abandoning the colotomy and making an anastomosis or short circuit.

Should the distal portion of intestine be closed?—Surgeons from time to time have advocated the complete closure of the intestine below the artificial anus but above the obstruction. This is however neither a safe nor a satisfactory measure. Between the opening and the stricture possibly a length of many inches of intestine exists, in which retention of secretion may give rise to serious results. Provided a good spur is obtained, faecal matter will not pass on into the lower segment, and with this the surgeon will be wise to rest content.

Narrowing, or the Occurrence of Prolapse at the Artificial Anus.—Unless the bowel has been brought well forward so as to make a good spur, the aperture will very probably contract within the next few weeks. Digital dilatation is, as a rule, sufficient; but if a firm scar has been allowed to form, it must be nicked in two places with a bistoury and stretched with the fingers or dressing forceps.

A not infrequent result is prolapse of the intestinal wall, especially if the abdominal wall be flabby or the opening be made too large in the muscles. This prolapse after colotomy is to some patients a most serious drawback. It can be remedied to some extent by the use of a belt and rubber pad; now and then it will be worth while to perform a second operation, such as cauterisation of the prolapsed part, narrowing the orifice by suture, etc.

RIGHT INGUINAL COLOTOMY.

Opening of the Cæcum.—When the operation is carried out upon the right side, the cæcum is opened.

The steps of the procedure differ in no essential from the operation as above described.

The bowel has of course no mesocolon, and none of the measures which involve a dealing with that membrane can be carried out upon the right side:

The cæcum is always very readily to be found, and is easily drawn into the parietal wound, secured, and opened.

Under equal conditions, the operation is simpler upon the right side than upon the left.

When a doubt exists as to the position of the obstruction, it is well to remember that the cæcum can, in all ordinary anatomical circumstances, be opened through a median incision.

I have many times made an artificial anus in this situation. One of such cases is described in the *Lancet* for October 29, 1887.

Results.—The mortality of the operation of colotomy—and it is assumed that the procedure is inguinal colotomy—has been greatly reduced within recent years. The risk of an inguinal colotomy carried out when but little obstruction exists is probably fairly represented by 3 per cent. If there be complete obstruction at the time of the operation the risk may rise to 20 or even to 30 per cent.

CHAPTER X.

THE OPERATIVE TREATMENT OF INTESTINAL OBSTRUCTION.

It would be beyond the purpose and limits of this book to enter into the question of the treatment of intestinal obstruction by operation with any attempt at precision or completeness. I have dealt fully with the subject in the 1899 edition of my work on "Intestinal Obstruction," pp. 449 to 560.

The subject involves the indications for operation and the proper selection of a mode of procedure, rather than any definite or quite special surgical method.

In the account that follows, no more is attempted than an indication of the general lines upon which the operative treatment of intestinal obstruction is conducted.

Purpose of the Operation.—It must be assumed that, in speaking of intestinal obstruction, reference is made principally to the acute or sub-acute forms of that affection. In chronic forms of obstruction a definite treatment can be carried out with greater precision: the diagnosis is usually more accurately made; there is less urgency; there is an absence of violent symptoms, and any proposed operation can be carried out with deliberation.

In the acute cases the progress of the trouble is often terribly rapid, the symptoms are violent, the need of immediate relief is very urgent, and symptoms which in a chronic case may assist the diagnosis are probably masked by narcotics.

Many cases when seen by the surgeon are seen too late. Laparotomy for intestinal obstruction is regarded by some as literally a "last resource," and the patient is not considered to be ready for operation until he is *in articulo mortis*. In not

a few instances the previous treatment has compromised the success of any interference by operation. The engorgement of the bowel has been increased by aperients, and the normal reflexes have been impaired or annihilated by excessive doses of opium and belladonna.

Operative treatment, to be successful, must be carried out early. The abdomen should be opened as soon as the diagnosis is reasonably clear. Operation should be regarded as the first resource, inasmuch as it is the only resource.

It has been clearly enough shown that when once the symptoms of undoubted strangulation have appeared in connection with a hernia, nothing is to be gained by delaying the usual operation by even an hour.

The risks which attend delay, and the dangers which attend uncertainty, are infinitely greater than those which belong to the mere opening of the abdomen in the median line.

In the carrying out of an operation the surgeon will have two purposes in view—(1) the relief of the dangerously-engorged bowel above the occluded part, and (2) the removal of the cause of the obstruction.

In many cases the attainment of the second object will include the first, but this is not so in all.

The belly may be opened in an advanced and acute case, a simple band may be at once discovered and divided, and the abdomen closed. The case may appear very simple and very fortunate. The cause of the obstruction is removed, it is true, but the greatly distended and engorged bowel above the site of the divided band is not necessarily relieved.

It is filled up to the very stomach with a foul and fæculent fluid, by which the patient is being poisoned. The gut is paralysed, the normal reflexes are lost, there is no peristaltic wave to free the many bends and twists which must be undone to secure a free passage, and the patient dies with some pints of the foulest and most putrid matter still lodged in a viscus possessed with an instinct to absorb its contents.

In such a case as this it is not the removal of the band which is the most urgent matter; it is the complete evacuation of the engorged bowel.

It is well in the acuter forms of intestinal obstruction to hold in mind that the patient is not dying because a band or an adhesion presses upon the bowel, and that it is not the cancerous stricture which has become suddenly blocked up that is of itself bringing about death; but that the urgency depends rather upon the extreme engorgement of the bowel above the site of the obstruction.

It is obvious that the two conditions cannot be logically separated, but at the same time it is essential to recognise that the surgeon's first object should be rather to relieve the obstructed bowel than to remove the cause of the obstruction; and it must not be forgotten that the attainment of the latter purpose may not be followed by the attainment of the former.

There are cases, however, where another element may predominate, and these are represented by instances in which a vast peritoneal surface is implicated in the obstructive lesion. Such are volvulus of the sigmoid flexure and cases of obstruction by bands where the constricted bowel is represented by many coils, and, indeed, by many feet of intestine. In such examples death may follow apparently from the extensive peritoneal lesion before a period at which it becomes evident that the engorgement of the bowel above the obstruction is a predominating feature.

Still, in spite of what may be urged as exceptions, the facts remain that laparotomy in acute intestinal obstruction is attended by a terrible mortality, and that the best results so far have followed in those cases in which the contents of the distended bowel have been evacuated. Enterotomy may appear to be a somewhat unsurgical procedure, and not a very brilliant or complete operation; but still it can claim results which appear to indicate the direction in which surgical measures should tend.

In threatened suffocation attending the impaction of a foreign body in the larynx, experience has shown that it is better to perform tracheotomy first, and to search for the obstructing foreign body afterwards.

Management of the Most Urgent Cases.—In these cases there is distinctly no time to be lost. The patient's

condition is such as to forbid any but the slightest operation, and the surgeon's great object is to relieve the distended bowel with the least possible disturbance of the patient.

The patient is enveloped in warm blankets, and hot bottles are placed about the extremities. The operation, such as it is, is performed as the patient lies in bed. No anæsthetic can be administered. If one be attempted, it will be noticed that the patient becomes rapidly insensible, and very often, just as the surgeon takes the knife in his hand, there is a great rush of faecal matter from the patient's mouth and nose, and the case is at an end. Some surgeons advise the use of cocaine, injected under the skin of the abdomen. The patients, however, in these cases are not in a condition to feel much pain. They stand the cutting part well, merely whining and moaning and wrinkling the brow as the surgeon proceeds.

A mask containing a drop or two of ether may distract their attention and cover their eyes while the actual skin incision is being made, but beyond this it is not well to go.

The *operation* consists in opening the abdomen in the median line below the umbilicus and performing an enterotomy. The incision should be as small as possible—just large enough to allow one distended coil to be drawn forwards with the finger. There should be no long searching for the cause of the obstruction. Every minute is of consequence in a case such as the present.

The bowel is rapidly fixed to the parietal wound by a few sutures which do not penetrate beyond the sub-mucous coat, and the gut may be best evacuated through a Paul's glass tube. If the glass tube is not at hand, a trocar and cannula of large size may be employed, to the end of which a long indiarubber tube is fixed. The contents of the gut are thus carried away from the wound. A way for the trocar through the outer coats of the intestine must be made with a scalpel. As the bowel is emptying itself, it may be more accurately secured to the margins of the parietal wound by a few more sutures.

The wound is treated in the manner already described.

It is most important in these cases that the stomach should be washed out. This may be done either before or after the

operation. The best apparatus is Leiter's irrigator, which acts upon the syphon principle. The washing-out should be effected by hot water, or hot water containing a little boracic acid.

This measure usually gives great relief, and the introduction of a large amount of hot water into the stomach improves the pulse and tends greatly to revive the patient. In long-neglected cases of strangulated hernia with fæcal vomiting, I believe that a patient's life has been more than once saved by a thorough washing-out of the stomach with hot water at the time of the operation.

In cases of obstruction which are a little less urgent some search may be made for the cause of the obstruction prior to the establishment of the artificial anus. A band may be found, and a strangulated loop may be relieved, without adding perceptibly to the danger of the operation. But the search should be rapid; and if the site of the obstruction be not found almost at once, there should be no delay in opening the bowel.

Management of the Less Urgent Cases.—In most of these cases the patient may safely be moved from the bed to an operating-table. The stomach should be washed out with hot water before the operation is commenced. An anæsthetic may be administered, but its use must be very cautious. Enough only is required to dull the patient's senses; and after the parietal wound has been made, enough only to restrain his movements.

The abdomen should be opened in the median line, between the umbilicus and the pubes.

The incision made should be large enough to admit the hand. Some surgeons advise a much larger incision. Kümmell recommends that the knife be carried from the xiphoid cartilage to the pubes. Such an excessive measure is obviously unnecessary; and it is difficult to conceive a case, unless it be one of extreme volvulus of a large sigmoid flexure, where such a wound would be other than embarrassing. Other surgeons have advised a very small median wound, one of not more than two inches, or one large enough to admit two fingers. If any search for the obstruction has to be made, a two-inch incision in a greatly-distended abdomen will be found to be of little use.

If the belly were flat and shrunken, it might possibly be sufficient. A determined attempt to relieve a case of acute intestinal obstruction through an incision with a maximum length of two inches belongs to the performances of sensational surgery, and an urgent case of abdominal disease is hardly suited for the demonstration of surgical feats, or for showing, not so much what can be best done to relieve the patient, as what can be effected through a two-inch incision.

When the abdomen has been opened, search is made for the site of the obstruction.

Great difference of opinion exists as to the best method to adopt in carrying out this search. In the multitude of counsellors there has as yet been little wisdom, and a plan that is vigorously advocated one year may be vigorously condemned the next.

In actual practice these cases present so many aspects, and are liable to such infinite variations, that it is, indeed, impossible to lay down hard-and-fast rules.

When the coils of intestine are greatly distended, they must be handled with infinite care. After a by no means rough manipulation, it may be found that the serous coat of the dilated coils has been split in twenty places. In the production of such lesions the operator's finger-nails often do no little harm.

The entire hand should not be introduced into the abdomen until every other means of examination has been exhausted; and an indiscriminate and purposeless pulling about of coils of intestine is to be avoided.

The method of making a very large incision, and of at once dragging out as much bowel as possible, has little to commend it.

As soon as the abdomen has been opened, three fingers may be introduced and the cæcum examined. If that viscus is found to be empty, the obstruction must be in the small intestine; if it be distinctly distended, then search must be made in the colon.

In the latter case the fingers may be passed into the left iliac region, and a stricture sought for in the sigmoid flexure or upper part of the rectum; or the empty colon below the

obstruction may be detected and followed as far as is possible. In the case of colic obstruction, the operation will probably be at once completed by performing a colotomy in the median line or in the left groin. A frequent site for cancerous stricture is the rectum at the brim of the pelvis or some part of the sigmoid flexure. When it is found high up in the latter, inguinal colotomy will not answer, and the abdomen should be sewn up in front and a lumbar colotomy performed if possible; if not, the transverse colon should be opened. The lower down in the large intestine the artificial anus can be made, the better for the patient. One leading into the cæcum is always a cause of irritation, owing to the fluid discharges from it. Paul's tube should be used in every case if practicable.

Cases which may be classed as acute are seldom fitted for a short-circuiting operation. At the same time it must be remembered that a short-circuiting operation has great advantages over a colotomy in the matter of comfort to the patient.

If the obstruction be not in the colon, the surgeon should pass his fingers over the hernial orifices, should examine carefully the ileo-cæcal and umbilical regions, and explore as far as is possible all parts of the pelvis. The commoner forms of acute obstruction should reveal themselves after such an examination.

If the seat of the trouble be not yet discovered, search should be made in the pelvis for any collapsed coils of small intestine which may belong to the segment below the obstruction. Such coils are very often found hanging down in the pelvis, and they often lead the surgeon to the occluded part, if they be carefully traced.

If so far no discovery of the trouble has been made, it may at least be urged that no injurious handling of the viscera has been carried out, and it will in many cases be desirable to desist, and to establish at once an artificial opening in the small intestine.

If, however, the patient's condition be such as to justify further search, the surgeon may, in the next place, allow some of the more distended coils of the bowel to protrude. They should be received in fine diaper towels which have been sterilised and then dipped

in hot carbolised water. The escape of these coils may render an inspection and a further digital examination possible. Failing any clue to the site of the obstruction, the surgeon may, if the case admit, proceed to introduce his hand into the abdomen. Without this somewhat extreme method of examination, certain forms of obstruction, such as that due to hernia into the fossa duodeno-jejunalis, or hernia into the foramen of Winslow, could scarcely be made out. This fact I have illustrated by an example of the latter form of hernia, in which I performed laparotomy (*Lancet*, October 13, 1888). In cases of great distension the introduction of the hand is almost impossible, or is likely to inflict considerable damage if persisted in. Such cases are not those in which the surgeon spends twenty minutes or more in searching for the obstruction, but are cases rather in which the gut is opened after a rapid and superficial examination.

Some surgeons (*e.g.* Kümmell—*Deutsche med. Wochenschrift*, No. 12, 1886) conclude the examination by resorting to exventration. The abdomen is fully opened up, the distended bowels are allowed to gush forth, and the cause of the obstruction is sought for in the open and simple manner which is adopted at a post-mortem examination.

Madelung brings a prominent coil into the wound, and, having opened it, attempts to empty the distended part of the bowel. He considers that fifteen minutes might well be spent in efforts to effect a more or less complete intestinal drainage.

The escape of the contents is aided by turning the patient upon the side, by pressing upon the dilated loops, and by passing a Nélaton's catheter.

Another plan is to expose the whole of the free part of the small intestine inch by inch until the loop occluded is reached. As the bowel is drawn out at the upper angle of the wound, it is passed back into the abdomen again at the lower. This plan is almost impossible when there is great distension; it involves considerable handling of the gut, and much expenditure of time.

The surgeon may, moreover, proceed with his investigation in the wrong direction, and may find himself, at the end of a tedious examination, at the duodenum.

Mr. Rand (*Brit. Med. Journ.*, December 22, 1883) has advised

an examination of the root of the mesentery as a means of avoiding the last-mentioned error. The attached border of the mesentery is only about six inches in length, and it is so obliquely placed that the right layer is directed a little upwards, and the left layer a little downwards. If a loop of the bowel be drawn forwards, and its mesentery be followed backwards to the spine, it may be often possible to tell which is the upper and which the lower segment of the loop, and also to form some idea as to whether it belongs to the higher or to the terminal parts of the lesser bowel. This is usually spoken of as the method by straightening the mesentery.

In acute cases these and other very extended and time-consuming methods of searching for the obstruction which are described can be but rarely justifiable. In chronic cases they may be appropriate enough.

After the cause of the obstruction has been found and relieved, it will in very many instances still be wise to evacuate the distended bowel.

The opening made may be closed as soon as the gut is considered to have sufficiently emptied itself; but it may with greater safety be left open for the time being, and be closed by a subsequent operation.

In reducing such loops of intestine as have escaped, the assistant should draw forward the extremities of the parietal wound with large blunt hooks, and so convert the opening into a slit, just as a man would hold up the mouth of a bag into which something is to be dropped. The coils are pushed back one by one by the kneading action of the fingers, which manipulate the bowel through a large thin flat sponge when the coils are few, or a diaper towel when they are many.

If the protrusion be considerable, the whole mass of the prolapsed intestine may be covered by a warm diaper towel, the edges of which are tucked in under the margins of the abdominal incision.

This reduction of protruded coils often occupies a considerable time. If, however, the distension has been properly relieved, the process should not involve the excessive manipulation which is called for in cases of great engorgement.

The sponges employed throughout the operation should be hot, and any cleansing solutions employed should also be hot. Special means must be taken to protect any prolapsed coils from exposure to cold.

The surgeon should not be too sparing of his incision in the parietes. It must be enlarged as required. The search for the seat of the trouble may be aided by inspection of the depths of the abdomen from time to time. In such an examination the nearest coils may be held aside with suitable spatulæ, and the margins of the wound by broad rectangular retractors.

Removal of the Cause of the Obstruction.

Strangulation by Bands or through Apertures.—Simple bands and adhesions, and large cords formed out of the omentum, may need to be divided in sections. The obstructing band should be cut short whenever possible, lest it give trouble at a future period.

When either the Fallopian tube or the appendix forms an obstructing band, an attempt should be made to free the bowel by traction, or by breaking down or dividing the adhesions which hold the organs in place. Failing this, the parts must be severed. It may be noted that, after a strangulation under the appendix has been relieved by simple reduction, death has occurred from gangrene of the little tube itself. In any case in which the appendix is involved that process should be excised.

The Fallopian tube may be treated as a simple band, and divided between two ligatures.

The appendix, after it has been cut across close to the cæcum, should have its proximal end closed by a double row of sutures—a continuous suture involving the mucous membrane, and a series of interrupted sutures involving the outer coats.

Meckel's diverticulum, when met with in the condition of a band, should be divided and treated as such; when it exists as a patent tube, its severed end should be closed with as much care as would be observed in closing divided intestine.

It is not wise to leave a long diverticulum attached to the bowel. If time permit, it should be cut short. Gangrene and perforation of this process have followed in cases where the obstruction has been relieved but the diverticulum left

undisturbed. When very large, the removal of the diverticulum involves an operation of some gravity and duration, and this it may be undesirable to attempt. The larger diverticula may be divided, and the proximal end clamped and brought into the parietal wound, where it plays the part of an artificial anus. Such an opening is more easily closed than one in the bowel itself. In such a case the distal end would be excised entirely.

In cases of strangulation through slits and apertures, it is well, when possible, to close the abnormal aperture with a few points of suture after the gut has been reduced.

Much difficulty may be experienced in dealing with retro-peritoneal herniæ. In a case of strangulated hernia at the foramen of Winslow, I not only could not reduce the gut through a laparotomy wound during life, but after death reduction was not effected until I had severed the hepatic artery, the portal vein, and the bile duct.

Volvulus.—In only the very simplest cases can volvulus be unfolded by mere manipulation.

No persistent attempts should be made to effect such a reduction. The huge coil formed by the distended sigmoid flexure cannot be dealt with through the comparatively small wound made in abdominal section. The involved bowel should be tapped and emptied. Its contents are mainly gaseous. The hole made can be clamped temporarily and the volvulus reduced. If the reduction be perfect, and if it show no disposition to return, the opening may be closed. Failing such evidence, an artificial anus must be established in it. I have found it impossible to reduce a volvulus of the sigmoid flexure on the post-mortem table until the bowel had been emptied.

It must be remembered that the reduction of a volvulus does not usually remove the anatomical condition that led to it.

Intussusception.—For the chronic form of intussusception abdominal section is the only suitable treatment; indeed, its diagnosis is usually difficult or impossible until the abdomen has been opened.

When reduction cannot be effected by manipulation in the manner to be described, resection with end-to-end suture (or

perhaps the use of Murphy's button) may be necessary. If, however, the patient be in an exhausted condition at the time of operation, it is safer to make a small artificial anus by means of Paul's tube above the intussusception, and defer the resection to a later period when the patient has regained strength. There is the less objection to making a temporary artificial anus, since the intussusception usually affects the colon. In several cases of chronic intussusception the part has been excised in the belief that the mass was carcinomatous.

With regard to the much more frequent condition of acute intussusception met with in infants and children, surgical opinion in the last ten years has steadily come round to advise abdominal section at the very earliest possible moment. The mortality following reduction by this method has fallen to about 60 per cent., including the cases of young infants, in whom the condition, whether operated on or not, is nearly always fatal. Spontaneous recovery is so rare that it may be disregarded, and although a fair percentage may be relieved by inflation with air or water, the method is uncertain and attended with the risk of rupture of the intestine. In all cases the greatest difficulty in reduction is met with at the end—*i.e.* in the last few inches—and with inflation it is difficult to tell whether complete reduction has occurred or not. The abdomen being opened, the surgeon may try inflation with water, and can then satisfy himself that the reduction is complete. As a rule, however, it is more convenient to reduce the intussusception with the fingers, applying pressure steadily from below on the intestine, aided by gentle traction exerted on the intestine above. The younger the patient, and the older the intussusception, the greater is the risk of tearing the intestinal coat, and it is especially in the last few inches that this accident is likely to occur. Considerable help in reduction may be obtained by steady pressure on the lower end of the intussusception, so as to lessen its engorgement and swelling.

Before commencing the operation the surgeon sees to the prevention of shock in every possible way; and rapidity in its performance is of importance. As little of the abdomen should

be exposed as possible, and in many cases reduction can be effected without bringing the intestine outside the wound; the patient's chest and limbs should be kept thoroughly warm by means of blankets, hot water pillow, etc., and at the end of the operation a small rectal injection of warm water and brandy may be advisable. The site of the incision will be to some extent determined by the position of the sausage-shaped tumour, which may have been previously felt through the abdominal wall. In the vast majority of cases the intussusception has begun in the cæcal region, and the most trouble will be found in unravelling it when this part is reached. Hence, if the tumour is small and limited to the right side of the abdomen, the incision may be made in the right semilunar line; if the lower end of the intussusception has been felt *per rectum*, the linea alba must be chosen. It should be noted that a small intussusception may be quite hidden behind the liver of a young child, and that this condition has unfortunately led to postponement of an operation at the only time when it could have saved the patient. Should the incision be made in the linea alba below the umbilicus, the surgeon should have ascertained that the bladder is empty; as is well known, the bladder in a child is an abdominal rather than a pelvic organ. As soon as the abdomen is opened sufficiently to admit four fingers the intussusception is felt for and its extent defined. The upper end of it is steadied by the fingers of the left hand, whilst steady pressure is made on the lower end with the fingers of the right hand. In some cases it is difficult and unnecessary to bring the tumour outside the abdomen, in others this is readily done.

As the last few inches are unravelled the difficulty increases, and frequently the peritoneal coat is slightly torn. Any rent should be sewn up afterwards with fine silk (Lembert's sutures). The vermiform appendix is frequently the last to emerge from the invagination. In a considerable number of cases, either a Meckel's diverticulum (turned inside out) or a polypus has been the cause of the intussusception. If possible, it should be excised through a small incision made in the length of the gut. (See Fig. 386, which is taken from the report of two

eases operated on with success by Mr. Rutherford Morison, *Lancet*, June 14, 1902.)

If at the operation, after many patient attempts, reduction

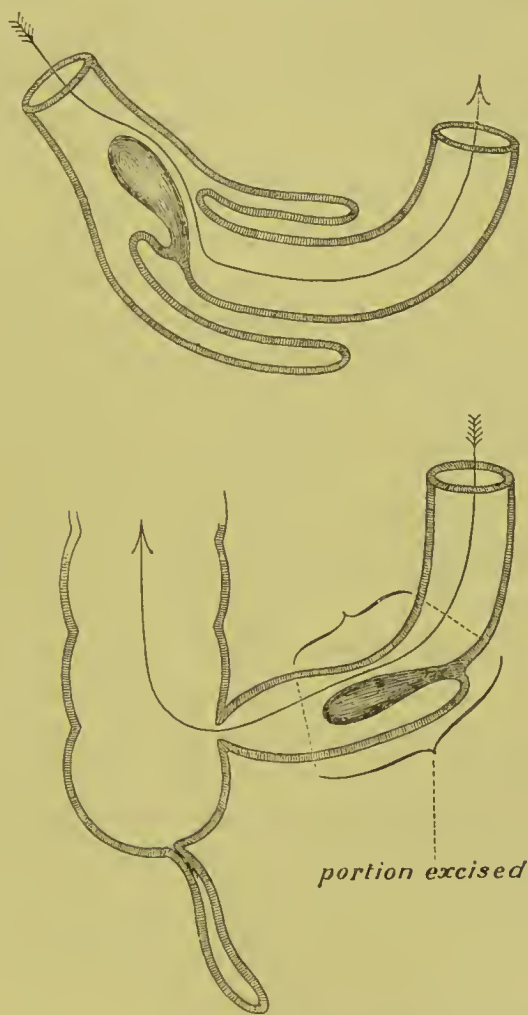


Fig. 386.—Diagram illustrating a case of intussusception caused by polypus, treated successfully by reduction and subsequent excision of the part shown between brackets (case under Mr. Rutherford Morison), copied from Mr. Morison's paper, *Lancet*, June 14, 1902.

cannot be accomplished, one or other of the following plans may be carried out:—

1. An intestinal anastomosis may be effected by suture (*see* page 330). I am not aware of a single case in which recovery has followed this procedure.

2. The involved segment of the gut may be resected and

an artificial anus established. This measure is of limited application, and could hardly be advised in a case where the invagination is extensive.

3. The establishment of an artificial anus without resection. This measure would appear to be recommended in irreducible cases where resection is contra-indicated and where time is pressing. It cannot claim to possess, on *a priori* grounds, any advantages over the first method named.

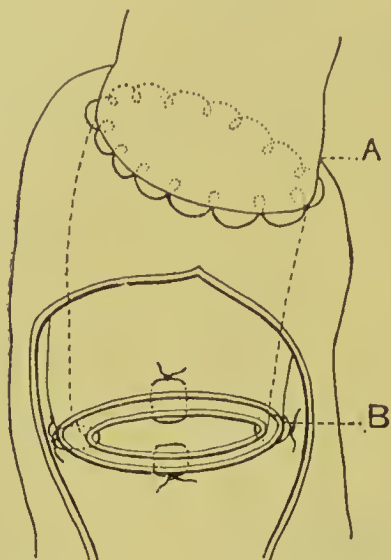


Fig. 387.—BARKER'S OPERATION FOR IRREDUCIBLE INTUSSUSCEPTION.

A, Continuous suture at neck of the intussusception; B, suture of the divided layers of bowel after excision of the intussusceptum. (From *Annals of Surgery*.)

4. The resection of the intussusceptum, and the immediate restoration of the canal by suture of the divided ends of the bowel. This method is theoretically the best, but it has been attended with a heavy mortality. Koehler reported five successes, Rydiger three out of twelve collected cases. On the other hand, Braun, Wiggan, and Barker record in all some twenty cases, every one of which proved fatal.

5. The following measure, devised by Mr. Barker, appears to offer the best prospects of recovery, and has so far been attended with the best results. The principle of

the operation is the excision of the intussusceptum through a cut made in the intussusciens.

At the neck of the invagination—*i.e.* at the point where the sheath receives the entering layer—the two portions of bowel are united by a continuous suture of fine silk (Fig. 387, A). This suture takes up the serous and muscular coats, and is carried on to the mesentery. If there be any sign of gangrene about the neck, more gut is invaginated before the suture is inserted. A longitudinal incision is then made through all the coats of the intussusciens along its free margin or convex side. The intussusceptum is thus exposed, is drawn out through the

incision made in the sheath, and is entirely divided as near as possible to its upper end. This involves, of course, the division of two layers or rings of bowel. Stout silk ligatures are passed through all the walls of the stump, and are tightly tied so as to keep the serous surfaces in contact and to control all bleeding from the vessels entering at the mesenteric attachment (Fig. 387, B). The earlier sutures are introduced before the section of the bowel is complete. Indeed, as soon as a convenient portion of the intussusceptum has been divided, the two cut layers of gut, which are thereby exposed, are secured by silk sutures. From four to six sutures will suffice for this part of the operation. The last of the sutures includes the stump of the mesentery, which is not divided until the suture has been tied. Care should be taken to see that the lumen of the intussusceptum is clear. The stump is cleaned and dried, and dusted with iodoform. It is then allowed to drop back through the incision into the lumen of the intussusciens. The longitudinal incision in the latter is now closed, and the abdominal wound adjusted by sutures. If there be any suspicion as to the state of the gut at the site of the operation a gauze drain may be introduced. If the intussusceptum cannot be drawn out through the cut in the sheath it must be divided *in situ*, and the securing of the stump proceeded with. In a case of Leszczynski's the amputated intussusceptum could not be extracted, and it was left to be passed by the stools. Many modifications of this operation have been devised, but they are of little moment, and appear to offer no material advantages over the original operation.

Note on After-treatment.—Feeding by the mouth should be begun as soon as possible after the operation. Small doses of tincture of belladonna have been recommended to prevent recurrence during the next few days.

Mr. Barker (*Lancet*, August 11, 1888) has collected seventy-three examples of intussusception treated by operation. The following is a summary of his tables :—

Laparotomy—Bowel reduced, 34 cases ; 22 died, 12 recovered.
„ Intussusception irreducible, 29 cases—
(a) Abdomen closed, 5 cases ; 5 died.
(b) Intussusceptum resected, 14 cases ; 13 died, 1 recovered.
(c) Artificial anus formed, 10 cases ; 10 died.
Artificial anus with laparotomy—10 cases ; 10 died.
Total—73 cases ; 60 died, 13 recovered.

Later statistics (F. S. Eve, B. Pitts, D'Arey Power, and others) give more favourable results—namely, from 40 to 50 per cent. of recoveries. The importance of doing the operation early cannot be urged too strongly.

In chronic colic invagination into the rectum the invaginated part has been resected with success. Failing this, attempts at reduction having already proved abortive, colotomy may be carried out.

Foreign Bodies.—In the case of some foreign bodies, *e.g.* gall-stones and the softer form of enterolith, it may be possible to break up the substance or to crush it without opening the intestine. In one case recorded by Mr. Clutton an impacted gall-stone was successfully pushed through the ileo-cæcal orifice. As a rule, however, it is impossible or unwise to carry out either of the above methods for the following reason:—

The bowel at the site of impaction will most probably be inflamed, the mucous membrane may be deeply ulcerated, or the coats of the intestine may be passing into a condition of gangrene. No attempt should therefore be made to disintegrate the calculus at the seat of impaction. The surgeon should endeavour to displace it upwards into the distended but healthier bowel above the obstruction, and deal with it there. Failing this measure, the foreign body may be removed by an incision made on the free border of the bowel and in its long axis. This incision also should be made through healthy intestine, and not directly through the gut at the seat of impaction. It is usually more convenient to make the incision in the dilated bowel above the obstruction.

The question of closing the incision in the gut at once by sutures, or of establishing an artificial anus, must depend upon the state of the intestinal wall at the seat of the impaction, and upon the degree of engorgement of the canal above that point. If the gut is healthy but distended, the coils should be emptied of their contents through the wound, taking care not to soil the adjacent intestine; the wound should then be sewn up with a double row of fine silk sutures. It should be remembered that gall-stones in the intestine are sometimes multiple.

If the gut be gangrenous at the seat of the obstruction, the part involved should be resected and an artificial anus established.

The stomach should be washed out before the patient comes round (if an anæsthetic has been used, which is not always advisable). Strychnia should be given hypodermically, and stimulants employed with a liberal hand. The subjects are usually old and in a deplorable condition from the constant vomiting, hence shock is severe, even though the operation be quickly performed. In one case after removal of a calculus from the ileum the patient, an old woman, was unconscious and apparently moribund for three days, ultimately making an excellent recovery. The danger of shock and peritonitis following the operation may be estimated from the combined statistics of Kermisson, Rochard, and Dagron—124 cases of operation for impacted gall-stone, only 38 recoveries: *i.e.* 30 per cent.

Other Forms of Obstruction.—Under this heading may be included in a general way varieties of obstruction due to causes which are less easily dealt with than is the case in the instances above given. In this category may be placed stricture, matting of adjacent coils of bowel together by many adhesions, direct compression of the gut by contracting adhesions, some complex forms of volvulus, and other allied conditions.

In these cases (1) an artificial anus may be established, and nothing more attempted. Such a procedure would be adopted for the more urgent and the more complex cases. (2) The involved part of the bowel may be resected and an artificial anus established. This measure may be advisable in cases of stricture, and in other instances where the resection can be carried out with ease and completeness. (3) Resection may be followed by immediate suture of the divided bowel. There is very little to be said in favour of this method in cases where any degree of obstruction exists. (4) The involved parts may be left undisturbed, and an intestinal anastomosis established. This procedure appears to have before it a fair prospect of success.

When the involved bowel is gangrenous, resection cannot be avoided; and such excision should be followed by establishing an artificial opening.

Results of Operative Interference in Acute Intestinal Obstruction.—Statistics dealing with this subject are apt to be somewhat misleading. The general mortality which is to be adduced from the various published tables is without doubt lower than that met with in actual practice, and does not represent the actual death-rate. It may be inferred that the majority of the successful cases are published, but that a very large proportion of the fatal cases are left unrecorded. In my work on Intestinal Obstruction (1899) I estimated the percentage of recovery after operation in all the forms of intestinal obstruction taken together at about 50 per cent.

Among the examples which would be reckoned as ending favourably are not a few which were—to judge from the published accounts—not instances of acute intestinal obstruction at all, but were examples rather of peritonitis. In such cases “much effusion into the peritoneal cavity” is reported, adhesions are encountered, and the cause of the imagined obstruction is not uncommonly ascribed either to adhesions or to volvulus of the small intestines.

One of the best collections of cases is that published by Dr. Curtis in the *Annals of Surgery* for May, 1888. He deals with the results of laparotomy in intestinal obstruction since 1873.

In a total of 328 cases there are 226 deaths and 102 recoveries—a mortality of 68·9 per cent.

It is made evident that this failure of the operation was due directly to the unfavourable condition of the patients; some were in a dying condition, others were exhausted, in many gangrene of the bowel was advanced. Dr. Curtis's tables afford a strong argument in favour of early operation.

In 247 cases where the cause of the obstruction was removed the mortality was 62·7 per cent.; while in seventy-four instances in which this was not done, the mortality was 86·4 per cent.

The highest death-rate was associated with cases where from any cause suturing of the bowel was carried out. The total number of such cases was forty-five, with a mortality of 86·6 per cent.

CHAPTER XI.

OPERATIONS FOR FÆCAL FISTULA AND ARTIFICIAL ANUS.

THE nature of the operation carried out in these cases will obviously depend upon the character, situation, and degree of the artificial opening.

For the purposes of classification, with a view to treatment, fæcal fistulæ may in the first place be divided into (A) those which involve the jejunum and ileum, and such parts of the colon as are normally provided with a free meso-colon, viz. the transverse colon and sigmoid flexure; and (B) those which implicate the more fixed segments of the large intestine—that is to say, the ascending colon, the descending colon, and the cæcum.

A. Fæcal Fistula involving the Small Intestine and the Free Parts of the Colon.—These unnatural openings may roughly be placed in three categories.

1. In the first the loss of substance in the wall of the bowel is small; the gut is not acutely bent upon itself; the orifice is small, and the opening in the skin is connected with the opening in the bowel by a sinus-like tract (Fig. 388, 1).

Such a form may be illustrated by the following case:—A surgeon made an exploratory incision in the median line of the abdomen in a young woman. The cut was small, and was below the umbilicus. It was probable, from her account, that the mass which was the subject of speculation was a fæcal accumulation. It would appear also that a loop of the lower ileum was accidentally wounded and the wound at once closed—the injured intestine lying close to the parietal wound, which was also sutured. Some days after the operation the wound broke down. Fæcal matter then began to escape, and a per-

manent fistula resulted, which, when I saw the patient, had been discharging for nearly twelve months. Through this opening practically the whole of the intestinal contents were evacuated, since a small motion was only passed *per anum* about once a fortnight. I closed this artificial anus at one sitting by the method described as *Method No. 1*, and the patient made an uninterrupted recovery.

It is to this form of the trouble that this method is especially applicable.

2. In the second class of case the loss of intestinal substance has been greater, the opening is larger, and the mucous mem-

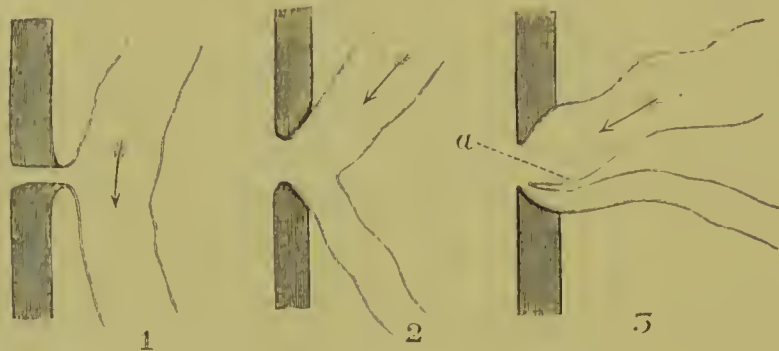


Fig. 388.—THREE FORMS OF FÆCAL FISTULA.

brane of the bowel is more directly in contact with the skin, and is more extensively exposed. There is no very considerable "spur," if any, separating the upper segment of the gut from the lower (Fig. 388, 2).

This form of artificial anus may be illustrated by that which is left after enterotomy, especially when followed by some sloughing of the bowel. It may result, also, after a resection, when the bowel has been partly united, and a fæcal fistula has been carefully established, with a view to a subsequent operation for closure. For this variety the procedure described as *Method No. 2* is applicable.

3. In the third form there has been a little or a great loss of substance. The opening is probably extensive, the two ends of the gut meet at the orifice at a very acute angle, and the lumen of the proximal segment is separated from that of the distal segment by a fold formed of the coats of the bowel at

its mesenteric border. This fold is known as the spur, or *éperon* (Fig. 388, 3, *a*). It forms a real septum, and prevents the contents of the gut from following their natural course, while it is a potent factor in the maintenance of the artificial orifice.

The treatment of this variety is considered in the section headed *Method No. 2*.

The best instance I have seen of this form was in a man who had suffered from strangulated inguinal hernia. He declined treatment. The gut sloughed, the coverings of the sac gave way, and the parts of the intestine which were concerned in the fistula were those which had formed the pedicle of the loop of strangulated bowel. This case was remarkable from the fact that, although the patient continued to prefer the nostrums of a herbalist to the uncertainty of what was termed "a necessary operation," the fistula, at the end of many months, closed spontaneously, to the gratification of the patient and the discomfiture of scientific surgery.

B: Fæcal Fistulæ involving Fixed Parts of the Colon.

—The most frequent of these are such as result from intentional or accidental wounding of the colon through the loin, and such as follow suppurative appendicitis. The abnormal opening will, therefore, be usually found either in the right iliac region or in the left loin.

So far as its characters are concerned, it will most commonly accord with the first of the three types mentioned above. There is a sinus, of varying dimensions, leading down to the bowel, which is comparatively deeply placed. In the right iliac region this is, perhaps, the form which the lesion will take without exception, the segment of gut involved being the cæcum.

The fæcal sinuses in the right inguinal district which result from appendicitis have a distinct tendency to undergo spontaneous cure, and of this termination I have seen many examples.

The fistulæ which are placed in the loin exhibit little of this disposition.

These colic sinuses are difficult to close by operation. The

great thing needed for success in any such operation is a ready supply of peritoneum. Two serous surfaces should be brought together:

In the sinuses which result from appendicitis the bowel is commonly buried in a mass of adhesions. The true peritoneum has been lost, and little material is available to meet the requirement that, in closing the opening in the gut, two surfaces of serous membrane should be brought into contact.

The procedure adopted for the majority of these cases is that described as *Method No. 1*.

An artificial anus in the loin is also, as a rule, very difficult to close. There may be no opportunity of making a complete union by means of united serous surfaces, and the obstacles in the surgeon's way when there has been much destruction of the bowel are considerable.

Methods of Operating.

Method No. 1.—For some time before the operation every means is taken to put the skin around the abnormal opening in as healthy a condition as possible. The eczema which is often present may be much relieved by constant attention to cleanliness, by keeping the part dry, and by dressing it with dry boracic acid powder, with boracic ointment, or such other application as may seem indicated. The diet must be so regulated as to allow of the formation of the least possible amount of intestinal *débris*. By careful dieting, and by the use of such drugs as salol and β naphthol, moreover, much can often be done to diminish the irritating properties of the escaping matter. (*See page 350.*)

The lower bowel should be well cleared by enemata.

The bowel above and below the opening should be washed out as well as is possible, both before the operation and during the administration of the anæsthetic.

The opening leading to the bowel is now plugged with non-absorbent cotton-wool. An elliptical incision is made in the skin. This incision will circumscribe the abnormal orifice, and will include the skin immediately around it (Fig. 389). This skin is seldom healthy, and the surgeon can well afford to sacrifice it. The long axis of the ellipse will be placed as is most convenient.

It will, when in the median line, be vertical; when in the iliac region, it will probably be oblique. The sacrifice of skin should be liberal. The lateral parts of the cut (*d* and *c*, Fig. 389) are cautiously deepened till the peritoneum is reached, and the peritoneal cavity well opened.

A portion of a gum-elastic bougie is introduced into the artificial anus, and made to serve as a guide.

There is often difficulty in clearly opening the peritoneum on both sides. It is desirable, however, that the lateral incisions (*d* and *c*) should be sufficiently wide apart to render it probable that the surgeon is clear of the adhesions which surround the sinus. The utmost caution must be observed in opening the abdomen, as a coil of adherent bowel may easily be cut into.

The tip of the finger is introduced through one of the lateral cuts, and the part explored. The position of the gut can be made out, and, if it be not closely adherent to the abdominal wall, the tract of the sinus can be traced.

The skin wound is now deepened all round, and, guided by the finger which is introduced into the abdominal cavity, is carried throughout through the peritoneum. There is thus isolated a little oval island, made up of the tissues of the abdominal parietes. Owing to the retraction of the skin, the actual sacrifice of muscular and aponeurotic tissues is small, and the parts concerned are usually found to be so modified by inflammation and atrophy that little normal-looking muscle tissue comes into the isolated patch. The tissues of the parietes about the abnormal opening are, as a rule, much altered, and such as are sacrificed can probably well be spared.

The bowel is now liberated as far as is possible, and is drawn

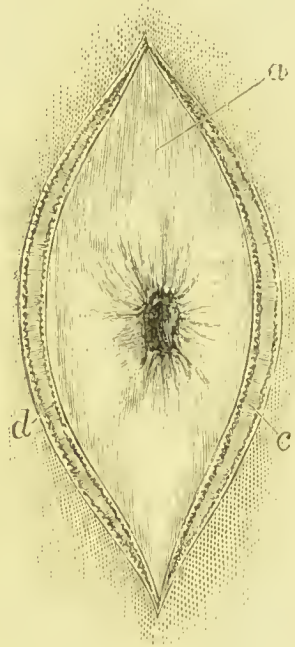


Fig. 389.—METHOD OF CLOSING AN ARTIFICIAL ANUS.

a, Eczematous skin around faecal fistula; *d*, *c*, Skin wound.

into the wound with the island of skin attached to it. Sponges are wedged in around the bowel, to prevent the entrance of any faecal matter into the peritoneal cavity. The surgeon now isolates, as well as he can, the mass of adhesive tissue which binds the gut to the parietes. This he does without opening the sinus, the position of which is indicated by the bougie.

The gut is clamped above and below by the fingers of an assistant. A small elliptical piece is excised from the intestinal wall. In the centre of this ellipse will be the orifice into the gut. The long axis of the ellipse will coincide with that of the bowel. The parts are cleaned, and the gap made in the



Fig. 390.—METHOD OF CLOSING AN ARTIFICIAL ANUS.

a, Skin with faecal fistula ; *b*, Tissues around the sinus ; *c*, Bowel with internal orifice of the sinus.

bowel is closed by a double row of sutures. The edges of the parietal wound are also united by sutures.

In the case of a deep sinus—such a one, for example, as may be met with in the iliac region leading to the cæcum—it is often possible to so cleanly divide the tissues around the sinus as to remove the diseased parts in a single piece, which will have the outline and arrangement shown in Fig. 390.

When a sinus burrows or follows a devious course, or is double, then this operation cannot be carried out without an accidental opening of the fistulous passage.

It is well, however, that the ill-conditioned inflammatory tissue in which the sinus is, as it were, buried, should be removed by dissection and scraping.

Above all is it essential that the abdomen should be opened clear of all adhesions, and that the bowel to be dealt with should be approached through normal peritoneum.

In certain of the numerous cases in which I have operated upon faecal fistulae due to appendicitis I have first opened the abdomen in the median line so as to be able to clearly explore the involved bowel without being hampered by adhesions. The operation for closure has been carried out by another incision

at the seat of the sinus as above detailed, but from time to time the median wound has been used to guide the steps of the operation. Under no circumstances should any attempt be made to close the fistula by dealing with the sinus. The sinus must be ignored, and the seat of the bowel lesion approached through the free peritoneal cavity.

Method No. 2.—The patient is prepared in the manner already described, and the skin around the opening is placed in as healthy a condition as is possible. The bowel is lightly plugged. The integument is excised by means of an elliptical incision, and the isolated part of the parietes thus defined is entirely removed before the conclusion of the operation. The abdomen is opened as in the previous operation. The involved loop of bowel is freed from adhesions as far as is necessary, and is drawn forward, together with the oval isolated piece of the parietes which still adheres to it.

The intestine is clamped above and below, either by a clamp or by the fingers of an assistant, the plug of wool is removed, and as much of the gut is excised as is necessary. (*See pages 316–18.*)

After the resection the divided ends of the intestine are united by suture in the manner described in a previous section (page 319).

In resecting the intestine it is of the greatest service if the continuity of the bowel can be left undisturbed at the mesenteric margin. The suturing of the bowel is carried out over a bone bobbin, which is peculiarly useful in these operations. Indeed, in no intestinal operation is the bobbin more valuable.

After the bowel has been united, the wound in the abdominal parietes is closed by sutures in the usual way. It is to be remembered that the lower segment of intestine will be much narrower than the upper.

The resection is carried out upon the lines already laid down.

Fæcal fistulæ of the third type—*i.e.* those in which a very marked spur exists—are best treated by method No. 2, a bone bobbin being used in every instance. Some surgeons, however in dealing with this type of fistula concern themselves only

with the removal of the obstructing spur or *éperon*. After the removal or obliteration of that fold, spontaneous closure of the artificial anus has, it is said, followed.

The simplest method appears to consist of introducing a substantial piece of thick indiarubber tubing into the two orifices of the bowel. The tube tends to straighten itself, and, as a consequence, the bowel also; it presses at the same time upon the *éperon*, and encourages its removal by displacement and absorption. A piece of silk is attached to the tubing, to prevent its slipping out of reach. Sir Mitchell Banks has obtained some excellent results from the use of this simple measure.

I think, however, that the resection operation is much more satisfactory, more speedy, and more certain.

CHAPTER XII.

REMOVAL OF THE VERMIFORM APPENDIX.

THE operation here discussed concerns the removal of the diseased vermiform appendix during a quiescent period when all inflammatory symptoms have subsided. I first advised this operation in 1887, and have elsewhere very fully dealt with the circumstances and procedure (*Med.-Chir. Trans.*, vol. lxxi., p. 165; *Lancet*, February 9, 1889; *Brit. Med. Journ.*, November 9, 1889; "The Surgical Treatment of Appendicitis," London, 1890; *Brit. Med. Journ.* and *Lancet*, June 28, 1902).

The risk attending this operation during the quiescent stage—*i.e.* at least three or four weeks after the symptoms of an attack of appendicitis have subsided—is remarkably slight, though its difficulties in certain cases are not to be under-rated. I have now operated on over 1,000 such cases with two deaths, and the mortality under all conditions may therefore be put down as 1 in 500. The mortality attending excision of the appendix during an inflammatory attack is much more difficult to estimate, but probably it approaches 20 per cent.

Anatomical Points.—In a small minority of cases the appendix can be felt through the anterior abdominal wall before operation. Fallacies are many with regard to this matter, the chief ones being the mistake of a lump of inflamed omentum or the outer edge of the rectus muscle for the appendix. "McBurney's point," which is so often referred to in this connection, is incorrectly supposed to localise the appendix at a point about two inches from the right anterior superior spine on a line drawn between it and the umbilicus. At this point, whether appendicitis has occurred or not, the individual is usually tender or sensitive to direct pressure. This, however, by no means

indicates that the appendix is situated beneath this spot. As the researches of Dr. A. Keith have shown (see Fig. 391), in the majority of cases the ileo-cæcal valve corresponds to the spino-umbilical line, and the root of the appendix will be

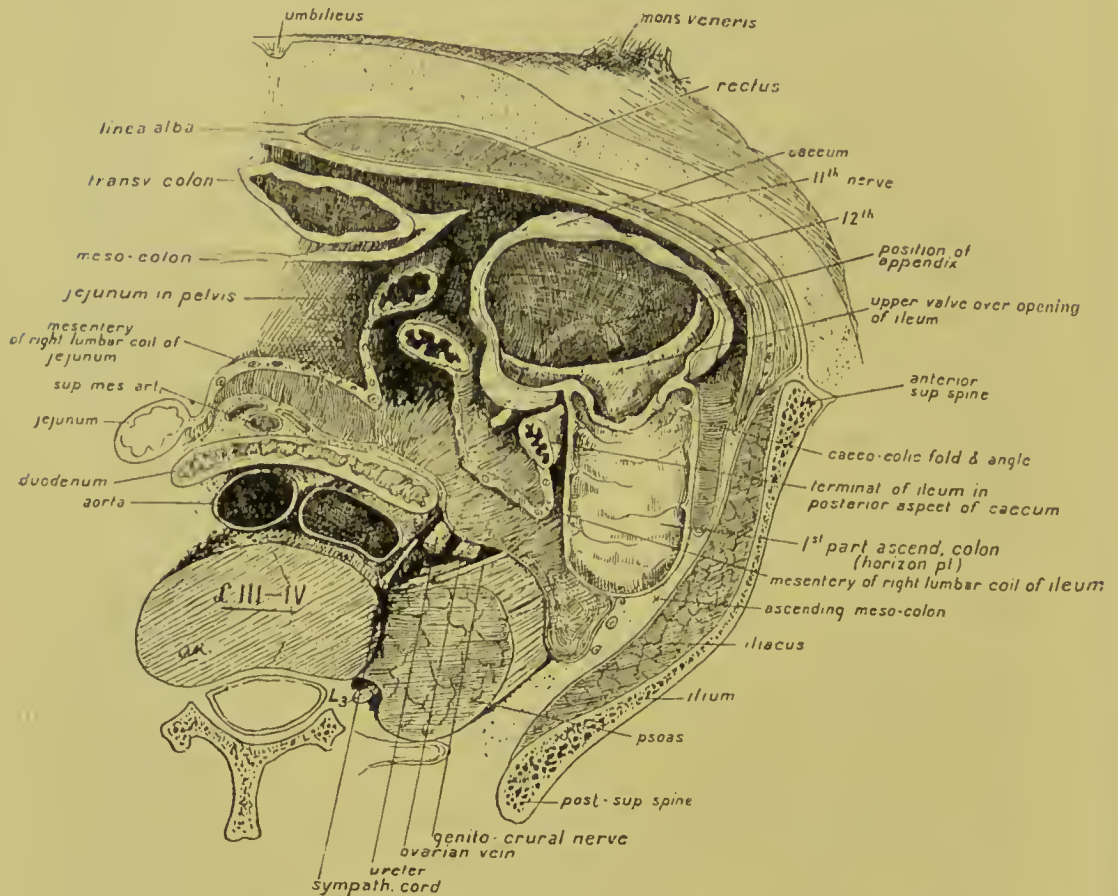


Fig. 391.—SECTION PASSING THROUGH A LINE DRAWN FROM THE ANTERIOR SUPERIOR ILIAC SPINE TO THE UMBILICUS.

The section passes through the ileo-cæcal opening, and lies wholly above the vermiform appendix.

placed more than one inch lower down and perhaps internally to it. The ileo-cæcal valve in a normal person is usually tender to pressure.

In the great majority of subjects (9 out of 10) the sacculus of the cæcum on the right side of the longitudinal band is larger than that on the left, and hence the attachment of the appendix may be approximated to the ileo-cæcal junction. A most useful guide is formed by the three longitudinal museular bands, either of which if traced downwards must lead to the appendix.

In most cases the appendix has a distinct mesentery in which runs its artery—the termination of the ileo-colic. This mesentery (mesoappendix) when present is always derived from the posterior surface of that of the ileum.

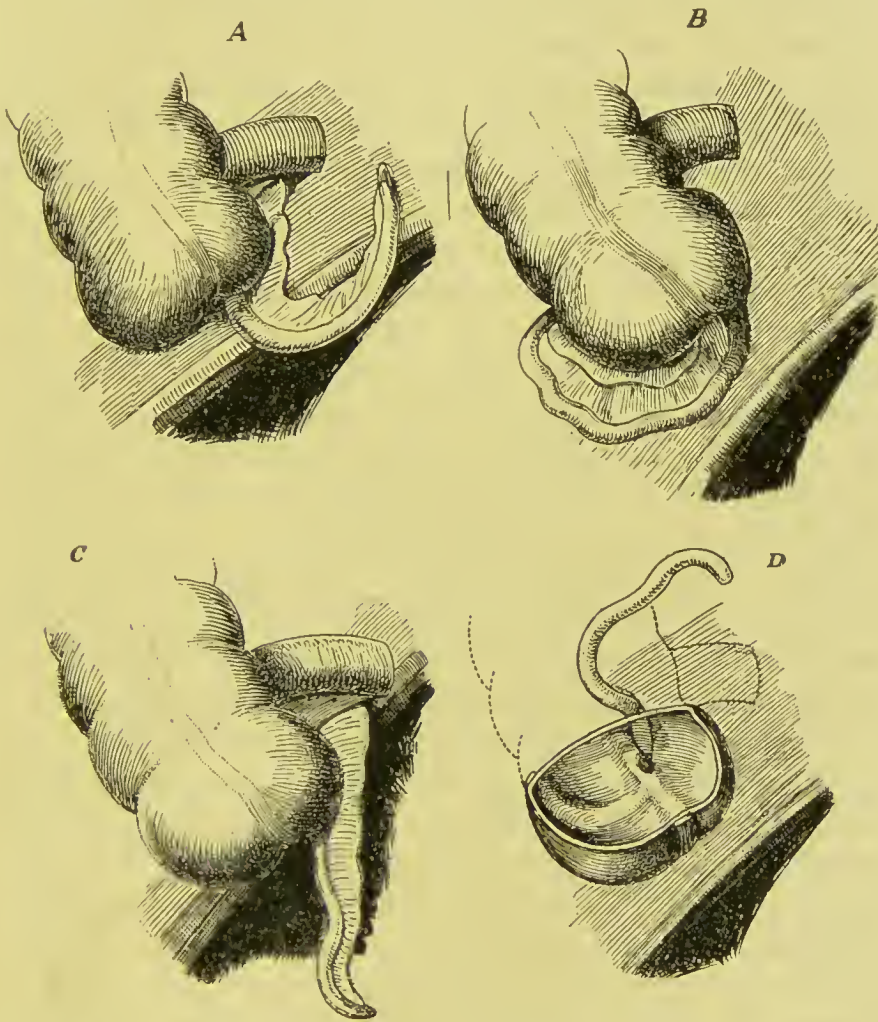


Fig. 392.—VARIOUS POSITIONS IN WHICH THE APPENDIX MAY BE FOUND.
(After Testut.)

A, Lying over the external iliac artery and curving upwards; B, Curving to the outer side of the caecum with its tip directed upwards; C, Hanging down into the true pelvis; D, Lying behind and concealed by the caecum. The meso-appendix is shown in A, B, and C.

In some instances the appendix is tied down to the iliac fossa. Its average length is $3\frac{1}{2}$ inches, but it may be as short as half an inch or as long as six inches.

The most frequent positions for the appendix (which, of course,

vary from time to time in the same individual) are (1) curved or coiling upwards and inwards behind the end of the ileum (Fig. 392, A); (2) over the brim of the pelvis and external iliac vessels, to which it may closely adhere (Fig. 392, c); (3) downwards and inwards behind and just above Poupart's ligament, and, more rarely (4), upwards along the outer margin of the cæcum and ascending colon (Fig. 392, B), occasionally reaching in front of the kidney up to the gall-bladder level; and (5) upwards directly behind the cæcum, by which it is entirely concealed (Fig. 392, D).

The appendix is supplied with blood by the posterior ileo-cæcal artery, a vessel which passes behind the end of the ileum to reach its destination. The artery to the appendix enters the mesoappendix and divides into three branches. The largest runs in the free edge of the mesoappendix and reaches the tip of the vermiform process. The other two reach the appendix at intervals of about half an inch. For the minute anatomy of the appendix see Fig. 393.

Preparation of the Patient.—A simple and somewhat restricted diet should be enjoined for a few days; the bowels should be thoroughly cleared with aperient and enema, and the usual antiseptic preparation of the skin carried out.

The patient lies quite flat upon the operating table.

The Incision.—The incision is about two inches in length, and is made obliquely across the line which joins the anterior superior iliac spine and the umbilicus. It is placed over the semilunar line. The three muscles of the abdomen are clearly divided at the outer edge of the rectus muscle. These muscles in this position are all aponeurotic. The rectus sheath is not opened. The peritoneum is divided with care, as the cæcum, ileum, or omentum may be adherent to the anterior abdominal wall at the point of the incision. The divided peritoneum on either side of the wound is neatly picked up with pressure forceps, and as these are drawn upon they act as retractors and facilitate the introduction of the fingers into the abdomen. Two fingers of the right hand are passed into the cavity, and the cæcal region is examined. In the female subject this examination should always include the right ovary.

Demonstrating the Appendix.—The cæcum is sought for and is gently drawn out of the wound by means of the two fingers. As a rule, this is readily done when there are no adhesions, and in such case the appendix is at once demonstrated. In a large proportion of cases, however, there are difficulties due to adhesions. The whole area should be well examined with the fingers, and the wound enlarged if necessary. The simplest way of finding the appendix is to identify the cæcum and the terminal part of the ileum, and where these two meet, the appendix will be found. The separation of the adherent appendix is often tedious. Care must be taken in clearing it of the iliac vein and of the ureter. Especial care is necessary when the ileum is closely involved in the adhesions. The adherent appendix may open by one or more ulcerations into the cæcum, colon, ileum, or rectum, and the apertures left in these viscera by the removal of the appendix must be carefully closed. The appendix is often adherent to the ovary or broad ligament, and occasionally it is attached to the bladder. In one case upon which I operated it opened into the interior of the bladder. The diseased structure may be buried in a mass of omentum, or may be closely united to the mesentery, or be buried in dense and almost cartilaginous tissue in the iliac fossa. It may extend upwards, and its tip be found under the liver. I have found it attached by its extremity to the left iliac fossa. A large proportion of the adhesions encountered are dealt with by the fingers. There must be no tearing, and no dragging of tissues apart with two pairs of dissecting forceps. The blunt dissector is often useful. All resisting adhesions should be well defined and then cut with scissors or a scalpel. In all these preliminary measures the operator should observe the rule to keep close to the appendix, and, above all, seek for its tip. The free end of the appendix is the key of the position when adhesions are very troublesome. When once that is found, the difficulties are nearly over.

In many cases of difficulty I have divided the undisturbed peritoneum of the right iliac fossa well to the outer side of the disturbed area, and by working along in the retroperitoneal tissue have reached the adherent bowel, and have readily

detached it, stripping off the peritoneum with it. The operator should never drag upon adherent bowel, especially upon adherent ileum. The only structure upon which considerable traction may safely be made is the appendix. This organ is apt to be much contorted, and is often bent acutely upon itself. Small caseous or even calcareous glands in the mesentery of the ileum are apt to mislead the operator when adhesions are widespread. A small hard gland may be mistaken for the end of the appendix. I have met with a Meckel's diverticulum involved in the adhesions around a diseased appendix. It was excised close to its origin from the ileum. The most difficult adhesions are met with when the appendix is adherent to the floor of the pelvis, and is possibly in communication with the rectum. A good electric light, a full retraction of the margins of the wound, a very free incision, and the Trendelenburg position are necessary in these very troublesome cases.

In dealing with such instances, the rule should always be observed to keep throughout very close to the appendix, which must be followed as a guide.

In detaching an adherent appendix an abscess cavity may be discovered. It will probably communicate with the bowel. It should be well sponged out, its walls scraped away, and its cavity lightly dusted with a little iodoform. In certain of these cases, but not in all, a gauze drain will be needed. A considerable amount of pale yellow, custard-like material may be found about an adherent appendix. It should be carefully scraped away, but no drain will in such instances be required. Caseous glands, if readily isolated, should be removed whenever possible.

Treatment of the Pedicle.—As the appendix is being isolated, care should be taken to demonstrate its pedicle. The pedicle represents the mesoappendix, or at least the source of the blood supply of the appendix. (Fig. 393 1'.) There may be no mesoappendix. The appendix may derive its blood supply direct from cæcal arteries, or direct from adhesions. I have found it supplied apparently wholly from adherent omentum. Sometimes the appendix is found to be fibrous and shrunken, and in such case its blood supply may be very small. I have removed such an appendix without securing any vessels by ligature.

may need a second ligature before these forceps are detached and the stump is allowed to drop back. When the appendix is adherent the adhesions are dealt with similarly, and the organ about to be removed is entirely freed from its blood-vessels.

Removal of the Appendix.—A ligature must be applied at the very base of the appendix. This ligature may be secured—if thought well—before the mesoappendix is dealt with. The ligature is of silk, and is passed through the gap between the vessels to which attention has been directed. The peritoneum is divided with a scalpel in a circular manner, at the point at which the ligature will come. The serous membrane is just sufficiently turned back to make room for the ligature. The turning back of a cuff or flap or hood of peritoneum is useless. Such a cuff makes the poorest possible covering for the stump of the appendix, and is probably absolutely bloodless. The ligature is securely tied. The appendix is then cut off with seissors close to the ligature. The seissors thus used are at once put aside, and must not be employed again until they have been freed of infection. The stump of mucous membrane is trimmed down, and the instrument or instruments used are put aside, as they will be infected. The practice of applying the actual cautery or pure carbolic acid to the appendix stump is to be condemned. So long as the divided stump is exposed it is held in position by the ligature which encircles it. The utmost care must be taken that it touches nothing. If it accidentally touches the parietal wound, the wound is quite likely to give trouble later on. The stump is now sequestered by a series of Lembert's sutures, made of fine silk. The sutures involve the cæcal wall around the stump of the appendix. The stump is thus inturned and hidden from view, and is perfectly secured. To cover the stump with a hood or flap of peritoneum derived from the appendix itself is not, I repeat, to cover it efficiently. Such a flap is often impossible to provide. All ligatures are cut short, and the cæcum is returned into the abdomen. Occasionally the peritoneal coat of the cæcum is not available for helping to cover in the appendix stump. In such an instance it is easy to find suitable serous membrane in the vicinity.

It is important that the appendix should be divided as close

to the cæcum as is possible. The stricture which has caused the trouble may be at the orifice of the appendix. The following case serves to illustrate this point. In a young man of twenty a surgeon "removed" the appendix for the relief of recurrent appendicitis. In spite of the operation, the attacks continued precisely as before. I opened the abdomen in due course and found that the previous operator had left a stump of appendix which measured three-quarters of an inch in length. It was much distended, and was strictured at its origin from the cæcum. The stump was removed, and the attacks ceased. In another instance the appendix was closely adherent to the cæcum, and had evidently been bent acutely upon itself. The surgeon had removed that part of the appendix which projected from the cæcal wall. The proximal part which was fixed to the cæcum and buried in adhesions had been left behind. This segment measured one inch, and had given continual trouble.

Closure of the Wound.—Small blunt hooks are introduced into the ends of the wound, and by means of them the edges of the wound are kept in perfect line, and the parietes are withdrawn from the subjacent viscera. The pressure forceps, which still hold the cut edges of the peritoneum, are removed by cutting away the little tag of (damaged) peritoneum which they grip between their blades. The peritoneum is united by a few very fine silk sutures. The rest of the wound is closed by means of silkworm-gut sutures, involving the skin and the muscles, which are neatly picked up in precise order. In muscular subjects the muscles may be separately united by a series of buried sutures of kangaroo tendon. In such cases there will therefore be a line of sutures for the peritoneum, for the muscles, and for the skin respectively.

The chief modifications of the operation relate to the incision employed. It has been recommended that after incision of the external oblique parallel to its fibres the two deeper muscles should be traversed between their fibres without dividing them; in other words, the deeper part of the wound is made at right angles to the superficial one, the fibres of the muscles being drawn aside. This method is clumsy and rather cramped, and will only suffice for uncomplicated cases.

CHAPTER XIII.

OPERATIONS ON THE STOMACH.

Anatomical Points.—The position of the stomach, and its relations to surrounding parts, are much influenced by the degree of distension which it exhibits, and are further apt to be modified by the effects of disease, either in its own walls or in the structures which surround it.

When empty, the stomach lies at the back of the abdomen, beneath the liver, and some little way from the surface. When distended, the greater curvature is elevated and carried forwards, the anterior surface is turned upwards, and the posterior downwards. The direction of the rotation depends mainly upon the fixity of the smaller curvature.

Normally, the lesser curvature looks upwards, backwards, and to the right (*see* Fig. 408, page 428). When distended, the anterior surface is brought well against the anterior belly wall, and the viscus may occupy the whole of the median line as far as the navel. In obstruction of the pylorus the dilated stomach may nearly fill the abdomen, and its greater curvature may reach to the groin.

Under normal conditions, the *cardiac orifice* is situated behind the seventh left costal cartilage, about one inch from the sternum. The *pylorus*, when the viscus is empty, lies just to the right of the middle line, from two to three inches below the sterno-xiphoid articulation, and on a level with a line drawn between the bony ends of the seventh ribs (Fig. 394). When distended, the pylorus may be moved nearly three inches to the right of this point (Braune).

The *fundus* of the stomach reaches on the left side to a point

as high as the level of the sixth chondro-sternal articulation, and is directly in contact with the diaphragm (Fig. 408).

The *uncovered area of the stomach* is normally represented by a triangle, the right side of which is formed by the edge of the liver, the left side by the borders of the eighth and ninth costal cartilages, and the base by a horizontal line drawn between the tips of the tenth costal cartilages (Fig. 394).

The tip of *the cartilage of the tenth rib* is an important landmark, and it is one not difficult to recognise. Tillaux points out that it has a distinct tip, that it is attached to the ninth cartilage by a ligament some six or seven mm. in width, that it plays over the latter cartilage, and produces under the finger a special crepitus (*bruit*). (See Fig. 394).

The position of the *lower edge of the liver* in the left sub-costal angle is liable to variation, but under normal conditions it may be represented by a line drawn from the ninth right cartilage to the tip of the eighth left cartilage.

The *pyloric opening* is small, and has an average diameter of 16 mm. This about corresponds to the diameter of a sixpenny-piece.

The following operations upon the stomach will be described :—

1. Gastrostomy.
2. Gastrotomy.
3. Operations for Hour-Glass Stomach.
4. Pyloro-plasty.
5. Resection of the Pylorus.
6. Gastro-jejunostomy.
7. Operations for Ulcer of the Stomach.

1. GASTROSTOMY.

This operation consists in establishing an artificial opening (*stoma*) in the stomach, through the parietes, with the purpose that the patient may be fed through the new “mouth.”

Gastrostomy is carried out in cases of obstruction of the gullet, especially in such as are due to malignant disease.

History of the Operation.—In 1837 Egebert, a Norwegian surgeon, advocated this measure in cases of stricture of the

œsophagus which were beyond local treatment. He described the details of the operation with great minuteness.

A little later, Blondlot demonstrated the practicability of forming gastric fistulæ in animals.

In 1849 Sédillot performed the first operation upon the human subject. The patient died. The same result followed in a second and a third case. Fenger carried out the operation in 1853. This patient also died. In 1858 Mr. Cooper Forster, of Guy's Hospital, performed the first gastrostomy in England, but with a fatal result. The operation was attempted by Günther, Gross, Curling, Bryant, and others, but in each case death ensued. The first satisfactory result was obtained in 1874 by Mr. Sydney Jones.

The practice of delaying the opening of the stomach was advised by both Egebert and Nélaton.

It should be noted, however, that the patient, if suffering from malignant disease of the œsophagus, is probably so near starvation at the time of operation that it is necessary to complete the operation and feed him on the same day. With modern methods there is no reason for dividing the operation into two stages.

Recent modifications, all having as their object the formation of an oblique or valvular opening instead of a direct one, have been brought forward by Witzel, Kader, Frank, and others. They will be noted later.

Preparation of the Patient.—If the patient is no longer able to swallow, the strength should be supported by nutrient enemata. One such injection, containing an ounce of brandy, may be given just before the operation. There is no need to adopt any especial means for distending the stomach. The body should be well covered up with blankets, and the limbs surrounded by hot-water bottles.

Deep anæsthesia is not required. I have performed the operation when so small an amount of ether has been given that the patient, while complaining of no pain, has yet been dimly conscious of all the steps of the operation. It may be performed under eucaine or cocaine injections (2 per cent. solution of either). The quicker the operation can be carried out, within reason, the better. The usual antiseptic preparation of the abdominal wall is made beforehand. As regards the position of the patient, he should be recumbent and close to the left side of the table.

The left arm may be placed behind the back. The surgeon

stands to the left of the patient, and the chief assistant to the right.

Instruments Required.—Scalpels ; blunt-pointed bistoury ; dissecting forceps ; pressure forceps ; seissors ; metal retractors ; blunt hooks ; curved needles and needleholder ; sutures ; ligatures, etc. ; sharp tenotome to open the stomach ; rubber tube or catheter of about No. 10 English size.

(1) **The Parietal Incision.**—The surgeon should endeavour to mark out the lower edge of the liver by percussion and palpation. The normal position of this edge has already been given (page 395). The liver, however, in the operation area may be found as high up as the level of the xiphoid cartilage, or as low down as the level of the ninth costal cartilage. In cases of stricture of the gullet, the organ is usually a little lower than normal, owing to the empty condition of the stomach and intestines.

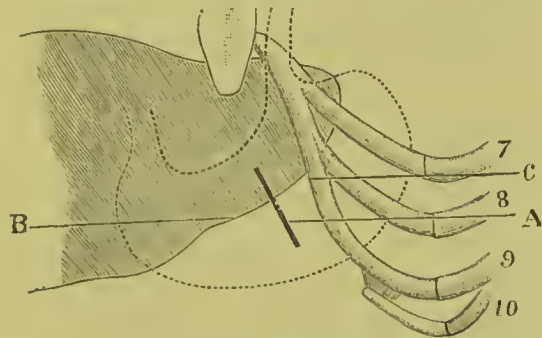


Fig. 394.—GASTROSTOMY.
 A, Incision ; B, Margin of the liver ; C, Margin of the costal cartilages ; 7, 8, 9, and 10, Seventh to tenth costal cartilages.

The incision is oblique, is parallel to the margin of the left costal cartilages, and is about one inch from that margin. Its length is about two and a half inches, and may be modified according to the thickness of the parietes.

The centre of the incision should correspond to a point from three-fourths of an inch to one inch below the margin of the liver (Fig. 394).

If the cut be too near to the ribs, the wound is apt to be needlessly disturbed by the movements of the thorax, and but little tissue is left on the outer margin of the wound to give a hold to the sutures. The edge of the cartilages comes also in the surgeon's way.

If the cut be too low down, the stomach is missed, or undue traction is made upon its walls. If it be too high up, the liver

comes in the way ; and although the stomach may be dragged up from beneath the liver, yet the sharp margin of that organ is apt to bear with injurious pressure upon the line of sutures which unite the stomach to the parietes.

The incision is carried through the tissues of the abdominal wall. The fibres of the external oblique muscle will be found to run almost at right angles to the line of the wound, and the fibres of the internal oblique to be nearly parallel with that line. The transversalis muscle will be cut transversely. The incision will probably cross the left semilunar line, in which case some fibres of the rectus are exposed.

The peritoneum is reached, and is divided to the full length of the original wound.

Modifications of the incision are described in the Comment upon the operation.

(2) **Exposure of the Stomach.**—Retractors are introduced into the wound, and search is made for the stomach. The liver will come into view, and below the margin of that organ the stomach may at once be detected. It is recognised by the smoothness and absolute opacity of its surface, by its faint pink colour, and by the thickness and stiffness of its wall, as demonstrated by pinching up a fold between the thumb and finger. To make the identification more certain, the relations of the viscus to adjacent structures, and especially to the liver, should be made out.

The colon has been mistaken for the stomach, and has been opened under the influence of that error. The stomach is usually contracted, and lies high up, under cover of the left lobe of the liver. In such case, the omentum or the transverse colon commonly presents. By means of a gauze sponge held in long pressure forceps, the colon may be thrust downwards into the abdomen, and the stomach thus brought into view ; or the surgeon may draw the colon downwards with his fingers. The omentum is more conveniently pushed away by means of the sponge, to the surface of which it readily attaches itself.

In any case of doubt the surgeon should follow the under-surface of the liver with his finger as far as the portal fissure.

Thence he is conducted to the stomach by the gastro-hepatic omentum.

The stomach should be drawn to the wound, and the spot at which to open it must be determined upon.

This spot should be as near the lesser curvature as possible, and at a part free from large veins. It is most important, however, that the new opening should be so placed as to avoid any traction upon the stomach.

As soon as the situation of the "stoma" has been determined upon, the stomach wall may be lightly seized at the centre of the selected area by means of pressure forceps. By means of these forceps an elongated pouch of the organ is drawn forwards and held in position while the sutures are being introduced.

(3) **Fixing of the Stomach.**—This is best effected by means of fine silkworm-gut or silk sutures. The needles should be of moderate size (about No. 5), and fully curved.

The stomach is drawn well forward into the wound, and each needle is made to take a good hold of the gastric wall. It should penetrate all the coats except the mucous. The needle is then carried through the peritoneum, and ultimately through the muscular layers of the parietes and the skin. In order to make the inclusion of the peritoneum simple and certain, it is as well to fix it on either side with pressure forceps, by means of which the membrane can be brought well into view while the needles are being passed.

The sutures should be so inserted as to circumscribe an area on the stomach about equal to a shilling-piece. From six to ten sutures will suffice. It is as well to introduce several of the main sutures before any are tied. The sutures should take up enough of the stomach wall to secure a good hold. The mucous coat must not be punctured, and each stitch must be very securely tied. There should be no dragging upon any part of the stomach. The sutures fix the base of the tubular pouch, which is drawn out into the wound. (Figs. 395 and 396.)

(4) **Opening of the Stomach.**—It is usually well to open the stomach at once in order to feed the patient. Should, however, the condition of the patient be sufficiently good to

warrant three or four days' delay, the surgeon may decide to defer the opening for this time. There can be no doubt that this delay, made from a somewhat needless dread of causing peritonitis, has frequently caused death from exhaustion. Immediate opening according to the plan described is perfectly safe, and is to be advised. The essential thing is to make the incision through the stomach wall small and valvular. A great

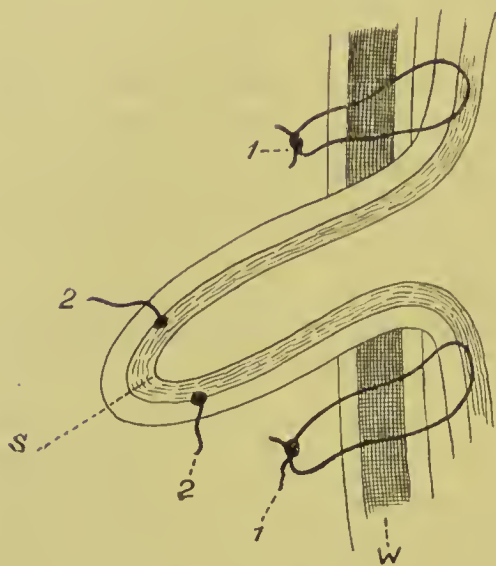


Fig. 395.—GASTROSTOMY.

A pouch of stomach (s) is drawn out and fixed by sutures, two of which (1 and 1) are shown passing through the abdominal wall (w). These, although shown loose, are securely knotted. A continuous suture (2 and 2) is passed through the outer coats of the stomach-pouch, which is then incised at s.

variety of methods have been devised with this object, but the following will be found as good as any. (See Figs. 395 and 396.)

A continuous silk suture is made to circumscribe a small circular area at the apex of the pouch, passing through the outer coats; before it is tied the stomach wall is incised with a tenotome within this area so as just to admit a No. 10 English rubber catheter, a few inches of which are then passed into the cavity. The stitch is then tied so as to fix the catheter without constricting its lumen, and the pouch invaginated for half

an inch or so. A second continuous suture (passed into the rubber) is then introduced, as shown in Fig. 396, which prevents the tube from slipping and maintains a valvular fold of the whole stomach wall. The rubber tube can be attached when required to a glass funnel. Feeding with small quantities of milk, strong beef-tea, etc., is begun with caution as soon after the operation as thought advisable, the tube remaining in for several days, and being subsequently introduced from time to time.

If care be observed, there is practically no risk of any

extravasation taking place during the feeding; and even if it be assumed that the peritoneal cavity is not securely sealed, there is still no difficulty in preventing such an accident.

If it be determined to effect an opening into the stomach within a few hours of the first operation, the mode of suturing above described will be found to suffice. The attachment of the viscus to the parietes may in such case be rendered doubly secure by a series of fine silk sutures which are interposed between the main stitches, and which concern only the parietal peritoneum and the outer coats of the stomach.

The actual opening of the stomach is a very simple matter. It is painless, and no anæsthetic is required. Indeed, if the condition of the patient does not warrant a general anæsthetic being given, all the steps of the operation may be carried out under cocaine.

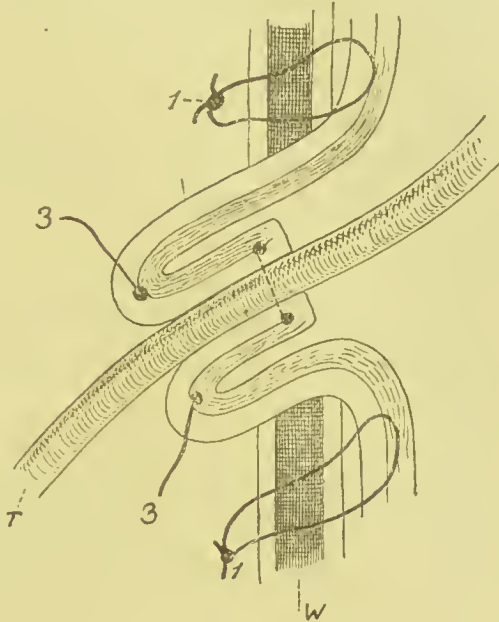


Fig. 396.—GASTROSTOMY.

The rubber tube (T) is introduced and fixed by tightening the suture shown in the previous figure. The pouch is then invaginated and a second continuous suture (3 and 3) maintains this condition.

NOTE.—The sutures 1 and 1, in both figures, should be more closely applied.

(5) **Feeding of the Patient and After-treatment.**—The amount of food introduced on the occasion when the stomach is opened must depend upon the patient's condition. If no food has been swallowed for a considerable period, it will suffice at first to introduce only a few drachms of milk mixed with a little brandy. The quantity can be gradually increased. If, however, the patient has been able to take some food through the gullet up to the time of the operation, his first meal may consist of from two to four ounces of a mixture of milk, egg, and brandy. This is slowly poured in through the funnel,

the gauze covering of which prevents any semi-solid particles from entering and blocking the tube. A pad of soft gauze packed around the aperture in the stomach will absorb any fluid which may escape. As a matter of fact, however, such escape is very seldom to be anticipated.

After the feeding the tube is left in place. It is secured to the ribs in the form of a coil by means of strips of plaster. Its end is left open, and serves to afford escape to any fluid which the stomach might attempt to reject. This open end is received by a pad of absorbent wool, or the tube may be closed in the intervals of feeding by a light clamp.

The skin around the margin of the "stoma" is kept very dry, is smeared with lanoline, is kept very clean, and well dusted with bicarbonate of soda.

The feeding should be repeated frequently, the amount given is slowly increased, but the quantity administered each time should be small.

The diet will consist of milk, eggs, beef-tea, soups, tea, cocoa, certain prepared foods, and a proper allowance of water.

All food administered should be of the temperature of the body. As time advances, more food may be given, but at less frequent intervals. The fistula may in process of time become enlarged, and then very finely-minced meat and pulped vegetables may be introduced into the stomach by means of a suitable syringe. On the other hand, a tendency to contract is sometimes shown, and must be overcome by occasional dilatation with a seatangle tent.

The patient's own feelings afford the best guide to the value of certain foods and the amount and mode of their administration. It will often be found that the patient after gastrotomy is able to swallow with greater ease for a time.

Leakage of gastric juice and regurgitation of food are often due to the stomach having been opened too near to the pylorus. The patient who is the subject of such trouble should be fed in the recumbent position, and lying upon the left side. Leakage may also be due to the gastric opening having been made too large.

The irritation produced by the escape of gastric juice is

best met by constant attention to cleanliness, by the very frequent changing of dry absorbent pads, and by the liberal powdering of the part with bicarbonate of soda.

Comment.—Many forms of incision have been advised and carried out. Some have employed an incision in the median line, others a vertical incision in the left linea semilunaris. Sédillot used a cross cut below the xiphoid cartilage. Howse prefers a vertical incision in the sheath of the rectus, a little to the inner side of its outer border. The vertical fibres of the rectus are exposed and are separated (not cut) with the handle of the scalpel. The posterior part of the sheath is thus reached. It is divided vertically, and the abdominal cavity opened.

The incision has the disadvantage of bringing the wound area somewhat closer to the pyloric region.

In carrying out the incision advised in the text, it should be remembered that, owing to the emaciation of the patient and the sunken condition of the abdomen, the part of the belly wall attacked is—as the patient lies upon the back—almost vertical. The integument, after passing over the margin of the ribs, turns suddenly backwards towards the spine, following the sunken abdominal wall.

There is no advantage attending the practice of stitching the divided edges of the peritoneum to the margins of the skin wound before the wall of the stomach is secured in place.

Several methods have been “invented” of fixing the pouch of stomach obliquely through the abdominal wall and then opening the extreme upper end of this tubular process, a catheter being secured in the usual way. They have not been given here, as the same statement applies to all—the oblique opening always becomes in a short time a direct one.

By many surgeons the area of the stomach circumscribed by the sutures is larger than that described in the text, and may equal in extent the surface of a penny.

The many different methods adopted of feeding the patient only serve to emphasise the fact that no rigid rule can be adhered to, and that this factor in the after-treatment must be modified according to the particular circumstances of each case.

Results of the Operation.—Gastrostomy cannot be said to occupy a very exalted or favoured position among surgical measures. It belongs to the forlorn category of last resources. It is for the most part carried out in patients who are dying of cancer, and whose death is being hastened by starvation.

One thing is certain, and that is—the operation is usually carried out too late. The condition of malnutrition into which the patient is allowed to sink is eminently favourable to the growth and progress of a cancerous mass. The stomach is allowed to pass into a state of atony before any attempt is made to introduce food into it.

The operation often gives great comfort to the patient, and relieves him of the distress attendant upon feeding by an œsophageal tube. Three to six months' relief is usually the most to be hoped for. In one case however of my own, life was prolonged by the operation for almost three years (*Brit. Med. Journ.*, June 20, 1903).

The troubles arising from the establishment of the fistula, the acute gastritis, the prolapse of the stomach wall, the inflammation of the skin caused by the escape of gastric juice, which were reported in connection with the early operations, are all to a great extent preventable, and these after-evils have practically vanished as the *technique* of the operation and the management of the case have been improved.

The most elaborate statistics of the operation are those collected by Gross (207 cases) and by Zesas (162 cases). Gross gives a mortality of 29·47 per cent., and reckons that life is prolonged for an average period of eighty-two days in the cases of malignant disease.

The mortality of the operation in cases of cicatricial stricture was about the same, and the average duration of life after the stomach was opened was 295 days.

Zesas finds that the mortality of the operation (since the introduction of antiseptics) is as high as 70 per cent. It is evident that he adopts a method of distinguishing between death from the operation and death from the disease different from that adopted by Gross. The periods of dying are divided as follows: Under 24 hours, 17 cases; under 30 hours, 69; between 1 and

12 months, 19; between 12 and 18 months, 1. The majority of the deaths are due to exhaustion, pneumonia, or peritonitis.

2. GASTROTOMY.

This term is applied to the operation of opening the stomach for the purpose of removing a foreign body, or for exploration.

The cutting into the stomach for the removal of a foreign body is an operation of some antiquity.

“A surgeon and lithotomist named Shoval” removed a knife-handle measuring six and a half inches in length from the stomach of a young peasant on July 9th, 1635. No sutures were applied to the stomach, and five only to the external or parietal wound. The part was dressed with “tepid balsam, bolar earth, white of egg, and alum.” The patient completely recovered (South’s edition of Chelius, vol. ii., page 391).

Many successful cases have been reported from time to time since that date.

The foreign bodies removed have included forks, knife-handles, spoons, plates of false teeth, and masses of hair.

The anatomical relations of the parts concerned have been already dealt with.

The preparation of the patient, and the instruments required, are considered in the section on Gastrostomy.

There is no need to attempt to bring about an artificial distension of the stomach before the operation.

The Operation.—The parietal incision may be made in the same position as is advised in gastrostomy, with this modification—that it may be conveniently placed a little less close to the margins of the ribs.

If the foreign body can be distinctly felt through the parietes, then the incision may be made directly over it. The cut has been made in the left semilunar line. In removing unusually large foreign bodies, such as are represented by masses of hair, the incision may be conveniently made in the median line. The exact position of any metallic body can be ascertained beforehand by radiography.

The incision should be at first about two and a half

inches in length. It may be enlarged subsequently as required.

The peritoneum is divided and the stomach sought for. If the contained foreign body be sharp-pointed, the manipulation of the stomach must be conducted with great care.

When the surgeon has determined upon the spot at which the opening into the stomach is to be made, two silkworm-gut sutures may be passed through the serous and muscular coats of the viscus, one on either side of the area selected for the incision. These sutures are allowed to form long loops, by means of which the stomach can be drawn forwards and held in place.

The stomach wall should be gently drawn well into the parietal wound, and before the opening is made the space between the viscus and the margins of the parietal incision must be plugged with sterilised gauze.

The incision into the stomach should be transverse to the long axis of the viscus, *i.e.* in the line of the blood-vessels.

As soon as the organ has been opened, the forefinger is introduced and the position of the foreign body made out.

It should be so manipulated as to place it in the position best suited for ready removal.

Forceps will probably be required to effect the extraction. Care must be taken not to damage the wall of the stomach by careless manipulation, or by attempts to drag the foreign body through too small an incision.

The next step is the closure of the wound by suture. Fine silk should be used for the purpose. The divided mucous membrane is first of all brought together by means of a continuous suture. This is best introduced by a small fully-curved needle, held in a needle-holder. The sutures must be well secured at each end, and must be tightly drawn throughout. The laxity of the gastric mucous membrane renders the application of this suture an easy matter.

The outer part of the gastric wound is closed by many points of Lembert's sutures. These are of fine silk, are introduced by means of an ordinary milliner's needle or a circular needle, and include both the serous and the muscular coats.

The details of the suture have been dealt with in the section on Enteroraphy (page 299).

Any of the methods employed for suturing the intestine may be adapted to the stomach. It is desirable, however, in any case that a special line of suture should be employed to unite the edges of the mucous membrane. For the outer row there is nothing better than the interrupted Lembert suture.

The parts having been well cleansed, the gauze is removed, and also the guiding loops of silkworm-gut from the stomach wall.

The parietal incision is closed in the usual way.

After-treatment.—This should be carried out upon the lines indicated in other abdominal operations. (*See* page 244.) Little food should be given by the mouth for two days. The patient should not be allowed to suck ice; there is no object to be gained by practically starving the patient; the stomach becomes irritable under such treatment. The diet for some ten days should be of the simplest and most easily-digested character, and the food should be given in small quantities and at frequent intervals.

Comment.—The incision in the stomach may need to be of considerable size. In Mr. Thornton's case the foreign body consisted of a ball of hair, and the gastric wound, after it had been closed by sutures, measured three inches.

Dr. Richardson, of Harvard, succeeded in 1886 in removing a plate of teeth which were impacted in the lower end of the gullet, and which were reached through an opening made in the stomach. The whole hand was introduced into the stomach before the removal could be effected. Dr. Richardson advises a long oblique incision close to the margin of the left costal cartilages.

3. OPERATIONS ON FIBROUS STRICTURE OR HOUR-GLASS CONTRACTION OF THE STOMACH.

In most cases the stricture is at or close to the pylorus, but the contraction due to the healing of a large ulcer towards the centre of the stomach may lead to the condition of hour-glass stomach—*i.e.* where the stomach is divided into two

pouches. The intervening constricting part is apt to be taken for the pylorus. The operations which have been found useful for this condition are many, but the main principles of them are discussed elsewhere (under the headings Pyloro-plasty and Gastro-enterostomy). It is therefore unnecessary here to do more than note the chief methods which may be indicated for the relief of hour-glass stomach. These are mainly taken from an excellent article on the subject by Mr. B. G. A. Moynihan (*Edin. Med. Journ.*, June, 1902).

1. If the pouches are very unequal in size, the larger being that into which the œsophagus opens, gastro-jejunostomy (see page 424) will suffice.

2. If the pouches are fairly equal in size and bulge downwards side by side, the surgeon's choice lies between gastro-plasty, performed in exactly the same way as a plastic operation on the pylorus, excision of the strictured portion, with immediate union of the two halves of the stomach, or the making of an anastomosis between them below the strictured part, or, finally, by doing a double gastro-jejunostomy, thus draining both pouches.

It is essential not to mistake one of the dilated pouches for the whole stomach, as has been done in several recorded cases. Sometimes there is contraction of the pylorus in addition to the centre of the hour-glass. Hence, in operating on such cases the whole of the stomach should be carefully made out on opening the abdomen before deciding what method to employ. The extent of cicatricial tissue and the condition of the patient will determine to some extent what method is the best, and sometimes it is necessary to perform two operations with an interval. Gastro-jejunostomy is both quicker and safer than such an operation as complete excision of the strictured part, and should be performed when the patient is in bad condition at the time of operation. Sometimes after the main pouch has been drained by a gastro-jejunostomy, a second plastic operation has been successfully carried out after a few weeks' interval. The difficulties attending operation in some of these cases are very great. Thus the constricted part of the stomach may be found so firmly adherent to the liver, the pancreas, or the anterior

abdominal wall, as to render any plastic operation out of the question. In separating such adhesions, severe bleeding may occur, or the thinned stomach wall may give way. The long continued vomiting and emaciation (perhaps repeated hæmatemesis) may render any operation dangerous. Mr. Moynihan records a total of fourteen cases of hour-glass stomach operated on by himself; of these, four proved fatal, but in one of them the sequel showed that the stricture had been malignant and not simple. In the remaining ten the recovery was most satisfactory. This proportion (70 per cent. of cures after operation for hour-glass stomach) is surprisingly favourable.

Dilatation of the Pyloric or Gastric Stricture (Loreta's Operation).—In the previous edition a full account was given of the method of digital dilatation of a contracted pylorus, performed through an opening made in the stomach on the proximal or dilated side. The risk attending this operation, its difficulties, and its failure to give lasting benefit, have led surgeons to entirely abandon Loreta's operation in favour either of gastro-jejunostomy or pyloro-plasty. I have therefore omitted all description of the method.

4. PYLORO-PLASTY.

By this term is understood a plastic operation, for the relief of fibrous stricture of the pylorus, in which no part of the intestinal wall is excised. It may be equally well carried out on any part of the intestine, but only when the stricture is ring-like, and does not involve much of the length of the gut. It is quite unsuited for cases of malignant disease. Its principle is simple. The narrowed part having been well defined, the stomach is opened to one side of the stricture, and a broad director (the old-fashioned hernia director is best) is passed through; on this the narrowed wall is completely divided into healthy tissue on the other side of the stricture. The longitudinal wound is then converted into a transverse one, by means of traction made with two hooks placed at the centre of either border. A double row of stitches is then applied, the deeper sutures (which may well be continuous) going through mucous

membrane and submucous tissue, the more superficial being the usual interrupted Lembert's stitches, which involve the serous and muscular coats. The hooks being withdrawn, an extra stitch is applied at either end, and the operation is

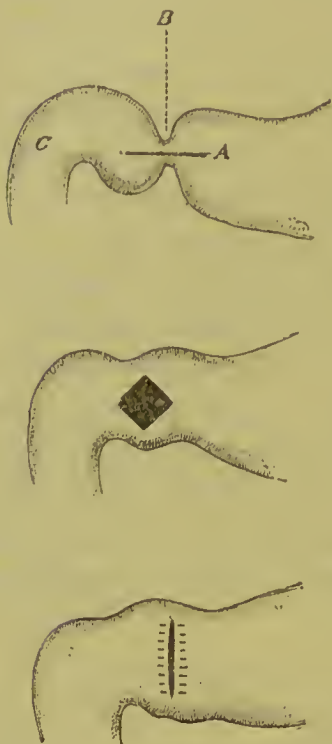


Fig. 397.—THE THREE STAGES OF PYLORO-PLASTY.

The upper figure shows the incision through constricted portion (B) from stomach (A) to duodenum (C). In the middle figure the wound is held open with hooks so as to become lozenge shaped. In the lower figure it is again converted into a linear wound and sutured up in the form shown. (Diagrammatic.)

completed by careful cleansing of the peritoneal surface of the pylorus and closure of the abdominal wound. The method will be readily understood by reference to Fig. 397. It has been largely employed for cicatricial stenosis following ulcer of the stomach, and occasionally when an active ulcer has been excised from the duodenum or pylorus with the view of preventing subsequent stricture. Pyloro-plasty displaced stretching with the finger (Loreta's operation), and is certainly safer and more efficient, but on the permanency of its results much doubt has been thrown, since many cases of pyloric stricture in which it has been performed have required subsequent gastro-jejunostomy, although the patients were relieved for a time. It is easy to see why the operation may fail in its object, since by doing it the surgeon actually increases the amount of scar tissue; further, the cicatrix left by an ulcer of the pylorus is rarely a perfect ring, and the operation is quite unsuited for broad, irregular scars.

Hence, if the pylorus is much scarred or distorted it is safer to do a gastro-jejunostomy. If the surgeon attempts a pyloro-plastic operation and is dissatisfied with the immediate result, he may well perform the other operation at the same time, if the patient's condition allows of it.

From the guarded way in which the operation of pyloro-plasty has been discussed the reader will infer that our opinion

of it is unfavourable. It has had an extensive trial, which, according to those with most experience in performing it, has resulted in an adverse verdict. It is undoubtedly ingenious, and might be expected to give a good and permanent result, but this has not been found to be the case. Even when limited to the cases for which alone it is suitable, those of fairly narrow fibrous stricture, recurrence of contraction is often met with after a year, or less. Moreover, gastro-jejunostomy is so successful that the position may be summed up in the words of a surgeon with much experience in stomach operations: "I have done pyloro-plasty many times, but I shall never do it again."

5. RESECTION OF THE PYLORUS, ETC.

History and Object.—This operation consists in removing the pylorus, together with the adjacent parts of the stomach and of the commencement of the duodenum. After the excision the divided walls of the stomach and the bowel are brought together, and united by sutures.

The operation has been performed on account of non-malignant disease in a few isolated cases, the condition being that of pyloric ulcer or of pyloric stenosis. Apart from these unimportant exceptions, the operation has been limited to cases of cancer involving the pyloric orifice of the stomach.

The possibility of excising the diseased pylorus was suggested by more than one surgeon about the beginning of the last century. Experiments upon animals made by Günther, Gussenbauer, Winiwater, Wehr, and others, at a later period, demonstrated the possibility of the operation.

The first operation upon the human subject was performed by Péan in 1879, and the second by Rydygier in 1880. Both patients died. The first successful operation was carried out by Billroth in January, 1881.

Pylorotomy has been somewhat extensively performed in Germany, but the operation has not been received with much favour in Great Britain. Care in selecting suitable cases and improvements in method and details of operating have, however, reduced the direct mortality during the last ten years; but, with a few rare exceptions, the cancer "returns" within six months or a year, usually in the liver or lymph-glands. In 1897 the surgical world was startled to hear that the whole stomach had been successfully excised in a case of carcinoma by Dr. Schlatter of Zürich. Hartmann of Paris and others have urged and practised a wide excision of the stomach when the extent of the cancer justifies it.

Mr. A. E. Barker, Mr. Mayo Robson, Mr. Rutherford Morrison in England, Prof. Kocher, and many other surgeons have described modifications of the operation, especially in the method of uniting the stomach to the pylorus. If the resection be very extensive, the direct union of these parts will not be possible, and then the best course will be to close both ends



Fig. 398.—LYMPHATICS AND ARTERIES OF THE STOMACH (from Hartmann's "*Chirurgie Gastro-Intestinale*").

C, Coronary artery; H, Hepatic artery with its pyloric branch and (A.G.E.) right gastro-epiploic. The lymphatics from the pyloric end of the stomach are seen to end in glands situated along the lesser curvature, and also in others below the great curvature.

completely by a double row of sutures and to perform a gastro-jejunosomy. It has been proved by Schlatter's case that a patient can live in comfort for at least a year after the whole stomach has been removed, and similar success has been obtained in a few other cases. An admirable account of the operation of pylorectomy and its modifications is given by Hartmann in his "*Chirurgie Gastro-Intestinale*" (Paris, 1901), and in what follows, this account, as well as those of Barker, Billroth, and others, has been utilised;

Anatomical Points.—The chief arteries concerned in the operation of pylorotomy are the coronary, coming direct from the celiac axis, and the gastro-duodenal branch of the hepatic. It is advisable to secure these by ligature at an early stage of the operation.

The lymphatic glands first infected by a pyloric cancer are those lying along the lesser curvature between the layers of the gastro-hepatic omentum and a chain situated below the greater curvature in the mesocolon. These, if enlarged, may be removed in one piece with the excised portion of stomach. But if infected glands can be felt close to the liver or in front of the vertebral column behind the pylorus, excision of the diseased pylorus is useless, and the surgeon should content himself with the temporary relief afforded by gastro-jejunostomy. There are further limitations. Pyloric cancer tends to infiltrate the peritoneum above and below, to contract adhesions to the pancreas and liver. Secondary nodules may form early in the liver, and their discovery as a rule negatives the idea of resection. Nodules in the wall of the transverse colon, in the great omentum or the parietal peritoneum, are unfortunately common with pyloric cancer. In the absence of such secondary deposits the chief point to ascertain is that the stomach is free from adhesions due to cancerous infiltration. This may be ascertained by making small apertures in the thin lesser omentum and mesocolon; with the finger introduced through these the mobility or otherwise of the pylorus can be ascertained. Unless it is mobile, resection should not be attempted.

Preparation of the Patient.—The stomach at the time of the operation should be empty. For a week or more previous to the operation, the diet should be very carefully regulated; and if sufficient food cannot be taken by the mouth, such feeding must be supplemented by nutrient enemata. Peptonised milk appears to be the most suitable food to be given by the mouth, and it may be supplemented by certain prepared foods, beef-tea, custard, and such other simple articles of diet as are readily taken by the patient and are well borne.

Some advise that for a few days before the performance of the excision the stomach should be washed out daily, either

with warm water or with some very weak warm antiseptic solution. This preliminary washing is, however, not essential.

The washing out of the stomach is best effected by means of a syphon irrigator, or "syphon stomach tube." Reversible stomach-pumps—and indeed all forms of stomach-pumps—are to be absolutely avoided.

The stomach may be washed out for the last time one or two hours before the anæsthetic is given. It will, however, suffice if the only washing-out be done on the table immediately before the operation.

The bowels must be thoroughly evacuated by enemata.

The usual antiseptic preparation of the skin should be carried out.

Every arrangement must be made to prevent undue loss of heat from the patient's body. The extremities should be enveloped in warm flannels, and a good supply of hot bottles should be at hand, to be employed directly after the operation.

It must be remembered that the operation involves a considerable time, and is attended with no small degree of shock.

The general arrangement of the table, the accessories of the operation, and the position of the surgeon and his assistants are the same as in other abdominal operations. (*See page 228.*)

Instruments Required.—Scalpel; blunt-pointed bistoury; dissecting and artery forceps; twelve pairs of pressure forceps; large pressure forceps; volsella; blunt-pointed scissors, straight and curved; sharp-pointed scissors; broad spatulæ; rectangular retractors; intestinal clamps; fine-toothed forceps; three dozen rounded intestinal needles; needle-holder; aneurysm needle; blunt hooks; sponge-holders; fine silk; catgut; straight or curved needles and suture material for the parietal wound.

One of the best forms of clamp for resection of stomach or intestine is that introduced by Sir T. Smith, which is practically identical with that called Doyen's clamp. Makins's clamp also is on the same principle. These instruments consist of two long supple arms of metal, which are approximated by clamp or screw pressure. Two pairs will be necessary. Smith's, Doyen's, and Makins's clamps may be compared in Figs. 377, 378, and 379.

The Operation.—The operation may be divided into the following stages:—

The opening of the abdomen.

The isolation of the pylorus.

The excision of the diseased parts, and the uniting of the stomach and duodenum.

The closure of the parietal wound.

First Stage.—The Opening of the Abdomen.—The pyloric tumour having been defined, an incision is made in the skin over it. This incision should follow the long axis of the pyloric end of the stomach, and its centre should correspond to the most conspicuous part of the growth. This parietal wound will, therefore, be more or less transverse. The full incision will be about four or five inches in length, will be above the umbilicus, and will incline from above and from the left downwards, and to the right. The upper third of it will be to the left of the median line (Fig. 399, *a b*).

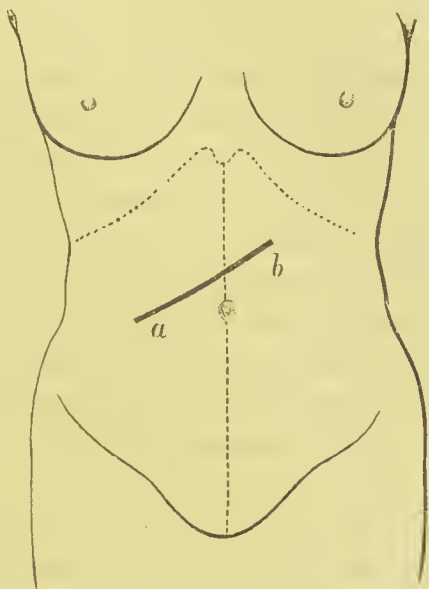


Fig. 399.—PARIETAL INCISION FOR PYLORECTOMY. (*Billroth.*)

If the pyloric tumour be very low, an attempt should be made to raise it before the skin is incised.

The incision should at first be only about two inches in length, in order that the fingers may be introduced for exploration. Such examination may reveal a condition which would induce the surgeon to abandon the operation.

The cut given is that known as Billroth's. Some surgeons employ a less transverse incision, others a vertical one in the median line, above the navel, or one just to the right of the median line, through the fibres of the rectus.

A convenient incision is that recommended by Hartmann, in which to a median vertical one is added a transverse cut

through the right rectus; the flap is held aside by a suture retractor.

The right semilunar line has been employed, and by some operators a eruciform incision has been adopted.

The transverse incision, when compared with the vertical one, gives the surgeon more room, and permits of a readier exposure of the parts. It is, however, more difficult to close; it involves a greater division of muscle fibre, more hæmorrhage, and it leaves a greater disposition to ventral hernia.

As soon as the abdomen has been opened, the diseased district is carefully explored, and its relations are noted.

Second Stage.—The Isolation of the Pylorus.—This is the most difficult and the most tedious part of the procedure.

The lesser omentum and mesocolon are perforated above and below the growth, as already described. The growth is drawn as far as possible into the wound, and a number of sponges (duly counted) are carefully packed around the stomach and pylorus, in order to prevent extravasation into the peritoneal cavity. The number employed must be noted at the time.

Slight adhesions to adjacent parts are divided, and the pylorus is freed as far as is possible.

The great omentum is now divided close to the greater curvature, and over as small an area as is consistent with the efficient removal of the growth. It should be clamped in segments by means of two pairs of pressure forceps. The omentum is divided between the forceps, and is then ligatured upon the distal side of either pair. In the place of this the epiploon may be dealt with in sections, which are isolated by means of double ligatures passed on an aneurysm needle. The segments thus secured are divided between the ligatures, which must be carefully tied.

The lesser omentum is treated in the same manner.

Any enlarged gland observed must be removed.

When the pyloric mass is free, a large flat sponge is passed beneath it, and the other sponges, packed around the part, must be rearranged.

Some surgeons now clamp both the stomach and the duodenum upon either side of the part to be removed. Others

clamp the duodenum only. Various clamps have been devised for this purpose.

If the stomach has been well washed out, and if, as is probable, but little food has for some time passed into the duodenum, the use of clamps is seldom called for. The orifice of the divided duodenum can be temporarily blocked with a fine piece of sponge. It is desirable that the area concerned in the excision should be well isolated by sponges.

Third Stage.—The Excision of the Diseased Parts and Uniting of the Stomach and Duodenum.—In describing this stage of the operation, I cannot do better than follow the very lucid plan adopted by Mr. Barker in his “Manual of Surgical Operations,” and divide the procedure at this stage into four steps. It must be noted that the cut surfaces, to be united after the excision, are of very unequal extent, and that the normal disproportion between the stomach and duodenum is increased by the distension of the former and the contraction of the latter. It is desirable, whenever possible, that the duodenum should be attached to the greater curvature of the stomach.

1st Step.—The stomach is divided about three-quarters of an inch from the border of the growth—or, at all events, in sound tissue. This is effected by means of strong, straight, blunt-pointed scissors. The cut is made obliquely from above downwards, and from left to right; it divides only about two-thirds of the depth of the organ, and



Fig. 400.—PYLORECTOMY: THIRD STAGE, FIRST STEP.
(Barker.)

leaves a wide gaping opening in the lesser curvature (Fig. 400). Bleeding vessels are secured with pressure forceps, and are subsequently ligatured if necessary. If the stomach be not

empty, it may now be freed of its contents, and very gently swabbed out with cotton-wool.

2nd Step.—The wound made is at once closed by means of a double row of sutures introduced in the manner already described, *i.e.* a continuous suture for the mucous membrane, and interrupted sutures for the serous and muscular coats (page 406).

When all the sutures are in place, the end of the stomach is reduced to about the size of the lumen of the duodenum. The sutures are not cut short at once, but are collected together and held in a bundle by a pair of pressure forceps. They serve

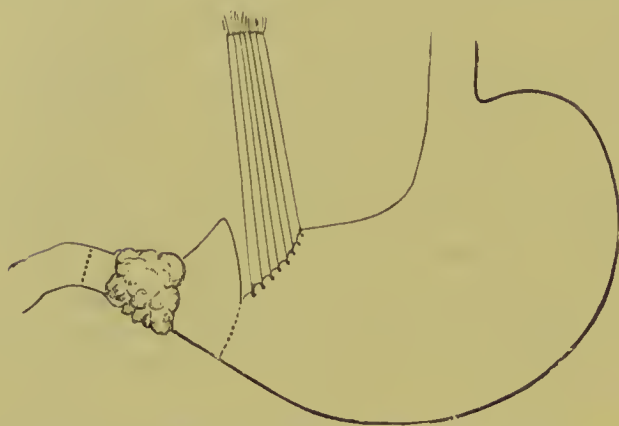


Fig. 401.—PYLORECTOMY: THIRD STAGE, SECOND STEP.
(Barker.)

to secure and steady the stomach during and after the division of its remaining third (Fig. 401). The best material for the sutures is very fine silk. The continuous suture should be introduced by means of a straight milliner's needle, and the outer row of Lem-

bert's sutures by means of curved intestinal needles held in a handle.

3rd Step.—The remaining part of the stomach is now divided with the scissors, the cut following the oblique line of the incision already made in the viscus.

The stomach is now free, and its inner surface may be further cleansed if necessary. The growth is grasped by means of the volsella.

The duodenum is now severed by an oblique incision which runs from above downwards and to the right. It corresponds to the incision in the stomach, and must be entirely clear of the growth. The division at this stage concerns only the upper half of the intestine.

The lower half remains unsevered, and it is by means of it, or rather of the growth which is still attached to it, and which

is grasped in the volsella, that the duodenum is held in place while the first sutures are being introduced (Fig. 402).

The margin of the orifice in the stomach is now adapted to that of the freshly - divided duodenum.

Where their upper borders come together, a series of close-set sutures are passed across from the one to the other, but are not yet tied. They are introduced after the manner of Lem-

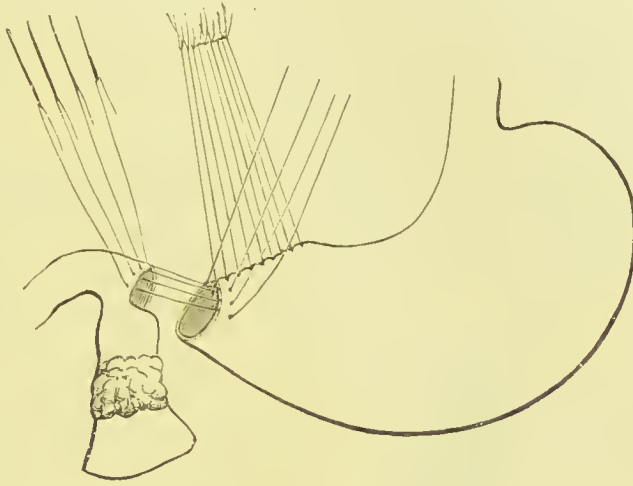


Fig. 402.—PYLORECTOMY: THIRD STAGE, THIRD STEP.
(Barker.)

bert's suture, and involve all the coats of both the stomach and the duodenum, with the exception of the mucous coat.

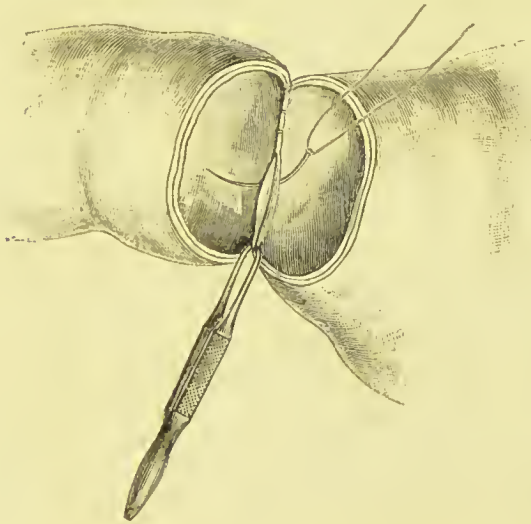


Fig. 403.—PYLORECTOMY: MANNER OF INTRODUCING
WOELFLER'S SUTURES. (Billroth.)

by means of curved needles armed with fine silk and carried in a needle-holder (Fig. 403).

The needle should pierce each layer about a centimètre

The posterior borders of the two openings are now brought into contact, and here the union is effected at once by means of Woelfler's sutures. The united sutures, which already pass between the upper borders of the two openings, serve to hold the two viscera together. Woelfler's sutures are applied from the inner side

from the cut edge. By this means a considerable breadth of the serous coats is brought into apposition. The needle is inserted between the mucous and muscular coats of the stomach, is carried through the muscular and serous coats of the viscus, then transfixes the same coats in the duodenum, and is brought out between the muscular and mucous layers of that bowel close to the cut edge (Fig. 404, *a*).

The edges of the mucous membrane fall naturally into apposition; for, owing to the strong retraction of the muscular coat, the mucous lining always projects a little.

If at any point this be not the case, a very fine suture can be carried through the mucous membrane and the ends cut short (Fig. 404, *b*).



Fig. 404.—WOELFLER'S SUTURES.

a, Deep suture; *b*, Superficial suture;
mc, Mucous coat; *ms*, Muscular coat;
s, Serous coat.

These sutures, both deep and superficial, are all tied tightly as soon as they have been inserted.

The sutures which already pass between the upper margins of the two openings may now be tied, and the superior and posterior margins of the orifices of the two viscera will thus be united.

4th Step.—The remaining half of the bowel is cut through in the same line as the first half. The parts are brought into close contact, and the remaining portions of the cut edges (*i.e.* the anterior and inferior parts) are united by means of a double row of sutures applied in the manner just described.

All the sutures are now firmly tied, and all ends are cut short. Extra sutures may be introduced at any spot where the union appears weak. A few additional sutures may very conveniently be introduced at the spot where the transverse row of sutures in the duodenum meet the longitudinal row in the stomach.

Fourth Stage.—*The Union of the Parietal Wound.*—The edges of the omenta are united to the edges of the altered stomach by a few points of suture.

The whole field of the operation is most carefully cleansed, the stomach is replaced, all sponges are removed and counted, and finally the margins of the parietal wound are united in the usual way.

Modifications of the Method.—The

appearance of the parts after the usual operation is shown in Fig. 405. It may

not be always possible to unite the duodenum to the greater curvature in

the manner described. The extent and the disposition of the growth may make it more convenient to attach the bowel to the lesser curvature, as shown in Fig. 406, or to suture

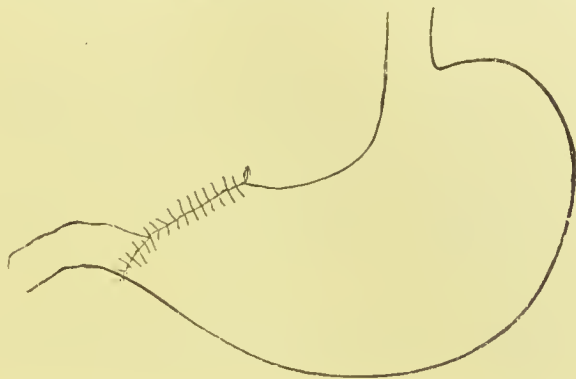


Fig. 405.—PYLORECTOMY. (*After Billroth.*)

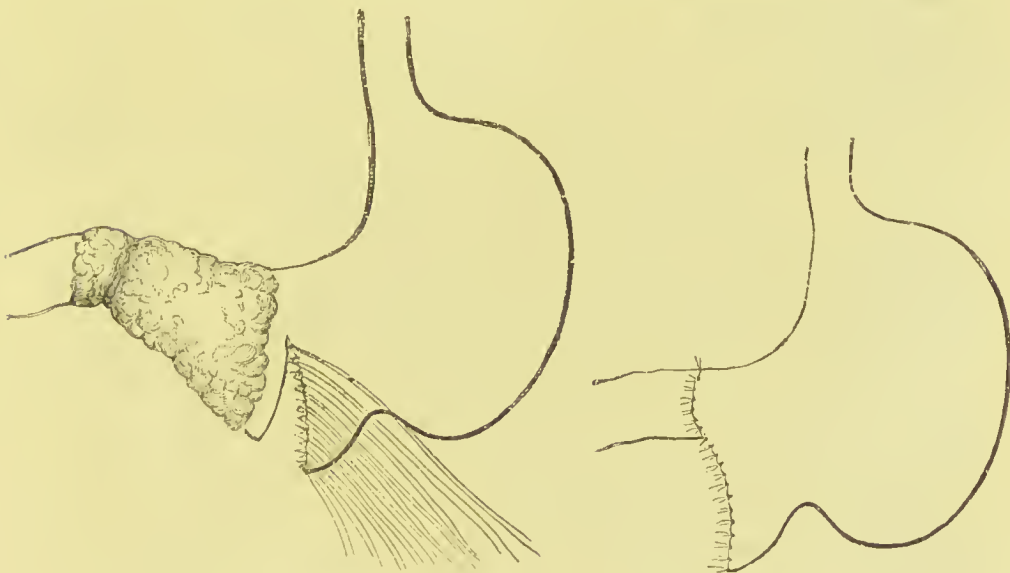


Fig. 406.—PYLORECTOMY. (*After Billroth.*)

it to the divided margin of the stomach midway between the two curvatures, as shown in Fig. 407. The methods involved in these modifications differ in no essential from that already described.

Prof. Kocher advocates complete closure of the stomach

wound by continuous sutures and implantation of the duodenum into another opening made in the posterior wall of the stomach. This method seems to have little advantage over ordinary end-to-end union.

But if the resection has been free, it may be dangerous or impossible to bring the remaining portion of the stomach over to the cut duodenum. Serious accidents—such as wound of the common bile-duct or portal vein—have occurred during the surgeon's attempt to free the duodenal segment in order to draw it over. The right course to adopt is to close both stomach and duodenal sections by continuous suture, and to make a separate gastro-jejunostomy, either by the anterior or posterior



Fig. 407.—PYLORECTOMY. (*After Billroth.*)

method (*see* page 424). Moynihan, Hartmann, Scott Riddell, and others have published cases illustrating the advantage of this method. The operation, including extensive removal of the stomach and lymphatic glands, closure of both ends, and gastro-jejunostomy, may take less time than a difficult pylorotomy with end-to-end suture after Billroth's method.

After-treatment.—This will be conducted upon the general lines laid down in the treatment of cases of abdominal section, and especially such as implicate the stomach. (*See* pages 244, 401, and 407.) Every measure must be taken to prevent the effects of shock. The operation is of long duration, lasting two hours, or even longer.

The feeding of the patient is a matter of great importance. The strength cannot be maintained by nutrient enemata, and by ice taken by the mouth. The best results have followed

in cases where food was early administered and was well borne. In one of Billroth's earlier cases a tablespoonful of cold sour milk was given every hour the day after the operation. The quantity was gradually and cautiously increased. In fourteen days the patient was taking meat.

As Mr. Butlin observes: "No definite rules can be laid down with regard to the kind or amount of food which should be administered; but, in all probability, the food which the patient could best tolerate before the operation will be the most useful during the first few days after it; and it is for this reason that the recommendation has been made that great care should be taken in the stages of preparation to discover the variety and form of food which suits best each individual patient."

Results.—The immediate mortality of the operation has greatly improved from the time that Billroth introduced it twenty years ago. Up to 1885 the deaths were probably at least 60 per cent.; they are now, in the hands of competent surgeons, about 25 per cent. The improvement has been due partly to asepsis and attention to detail, but still more to the selection of cases suitable for the operation and its early performance. The deaths occur mainly within twenty-four or forty-eight hours, from peritonitis, collapse, or shock. The operation must of necessity be a long and difficult one, with grave risk for patients already exhausted by pain, vomiting, and semi-starvation. The mortality must be compared with that of gastro-jejunostomy done in cases of pyloric cancer.

The influence which extensive adhesions have upon the result of the operation is well shown by Saltzmann.

In fourteen cases without adhesions the mortality was 35·7 per cent., in seventeen with slight adhesions the mortality was 64·7 per cent., and in twenty-six cases with extensive adhesions it was 91·5 per cent.

The final results in the cases of those who have survived the actual operation have not on the whole been good.

There have been a few cases in which cure has resulted, the patient remaining free from recurrence. It is, however, probable that these were not cases of true cancer but of chronic

non-malignant ulcer of the pyloric region. In the great majority death has followed after a few months' intermission.

Mr. Butlin, after an exhaustive examination of the statistics of this operation, comes to the following conclusion, which I would venture to endorse:—

“The excessive mortality due to the operation, the rapidity of recurrence in what have appeared to be most favourable cases for operation, the return of the symptoms of obstruction in some, if not many, of the cases, and the fact that there does not yet appear to be one case which can be claimed as a genuine cure, lead me to doubt whether the operation of resection of the pylorus for cancer is ever a justifiable operation.”

6. GASTRO-JEJUNOSTOMY.

This operation consists in establishing a permanent communication between the stomach and the first coil of the jejunum just below the end of the duodenum. It was first proposed as a substitute for pyloric resection in cases of cancer of that part of the stomach, but its use has been largely extended.

The procedure was devised and carried out by Woelfler in 1881 (*Zentralblatt für Chirurgie*, November 12, 1881). It was found that the obstruction was overcome by diverting the course of the food matters, that the patient was greatly relieved, that life was prolonged, and that no grave gastric symptoms supervened. In course of time it became evident that gastro-enterostomy was not so much a mere substitute for pylorotomy, or a *dernier ressort* when excision could not be practised, but an operation that in its results could be fairly compared with the older operation, and could be considered to be in many respects superior to it. It is now generally admitted that the majority of the cases of pyloric cancer can be better and more successfully treated by gastro-enterostomy than by excision of the diseased parts.

The published results of this operation, which are given on a subsequent page, tend distinctly to support this view.

The result of gastro-jejunosomy in average cases of pyloric cancer may be thus stated: The patient loses the distressing

symptoms of pain and vomiting, he becomes able to digest solid food without discomfort, and, in consequence, gains weight to a surprising degree. This condition of improvement lasts from two to six months, possibly twelve, during some of which time he may be able to return to work. Ultimately wasting again comes on with the progress of the cancer and its extension in the liver, etc.; the sickness probably returns, and the patient dies from cachexia or some intercurrent pneumonia, etc. In not a few instances, however, to the surgeon's surprise, the improvement is maintained year after year; it is unlikely that there has been cancer in these cases. It is practically impossible to distinguish, short of prolonged microscopic examination, the indurated lumpy pylorus associated with chronic ulcer of this region from cancerous stricture. In both conditions the lymphatic glands may be markedly enlarged. There is little doubt that most, if not all, of the permanently successful cases of pyloric resection in supposed cancer have been really of chronic inflammatory nature.

Hence the asserted advantage of pyloric resection over gastro-jejunostomy for cancer in obtaining a permanent cure in some cases falls to the ground. When such a result is obtained from either, the diagnosis has probably been mistaken.

The main test is therefore the direct mortality of the two operations—and here there is no question as to the lesser risk of gastro-jejunostomy.

The operation has been extended to cases of chronic ulcer of the stomach (1) when attended with recurring and severe hæmatemesis; (2) when stenosis has occurred at or near the pylorus due to cicatrisation of an ulcer; (3) when hour-glass contraction has developed from the same cause; (4) when symptoms of gastric ulcer have continued for some considerable time and have resisted careful dieting and medicinal treatment.

The object of the gastro-jejunostomy under these conditions is twofold—to relieve obstruction to the stomach by emptying its contents, and by giving rest to the organ to encourage healing of the ulcer.

History, etc.—The operation, as already noted, was introduced by Wöckler in 1881. The subsequent literature on the

subject is voluminous. Woelfler, Miekuliez, and Sonnenburg in Austria and Germany; Hartmann in France; Murphy and others in the United States; and Herbert Page, A. E. Barker, and Mayo Robson in this country, have made valuable contributions. The reader may be referred to Mr. Page's papers (*Med.-Chir. Trans.*, vol. lxxii, 1889), and to Mr. Barker's (*ibid.*, 1887, page 257; and to M. Hartmann's "Chirurgie Gastro-Intestinale" (Paris, 1902). A valuable account of experimental work in this operation and in lateral anastomosis generally is given by Messrs. Ballane and Edmunds in the *Med.-Chir. Trans.* for 1896, pp. 255 to 311.

Much discussion has taken place as to the relative advantages of anterior and posterior gastro-jejunostomy, but it will be most convenient to refer to this subject after describing the method of performing each operation.

In all cases of gastro-jejunostomy the first coil of small intestine below the fixed duodenum must be attached to the stomach (see Fig. 408). Not only is the wall of this part of intestine thick and well adapted for suturing, but it is all-important that food should pass from the stomach into the upper end of the gut so that digestion may be properly carried out. Thus, whatever method be employed, the surgeon must first find the termination of the duodenum, which is fixed in front of the aorta behind the transverse colon. The demonstration of the commencement of the jejunum is best effected by drawing the transverse colon upwards and by then passing the fingers along the under surface of the transverse mesocolon until the vertebral column is reached. Just to the left of the spine the terminal part of the duodenum will be discovered. This will lead to the jejunum, and traction upon the coil seized will demonstrate that it represents the very commencement of the jejunum.

It is important to favour, as far as is possible, the contents of the stomach passing into the descending limb of the jejunal loop. For this reason the intestine should be so sutured that its axis may correspond with that of the stomach—*i.e.* both running from left to right. Further, the direction of the loop secured should be obliquely downwards. This will be readily understood by reference to Fig. 408.

Instruments Required.—These are of a simple kind, and no special instruments are needed. Murphy's button or Mayo Robson's bone bobbin may be used at the discretion of the operator. Straight and curved needles threaded with fine sterilised silk should be prepared. A fine scalpel, dissecting and pressure forceps, and straight, fine-pointed scissors are essential. No clamps are required for either the stomach or the intestine.

Preparations for the Operation.—The usual antiseptic preliminaries have been carried out. A sand-bag beneath the upper part of the abdomen is often convenient. It is unnecessary to expose more than the region between the umbilicus and the sternum. Dry, hot, sterilised towels are carefully arranged all round this area.

It is desirable that the stomach should contain as little fluid as possible, and a preliminary lavage through a long rubber œsophageal tube should be carried out before the anæsthetic is given.

(1) **Anterior Gastro-jejunoscopy by Suturing.**—The abdomen is opened in the middle line above the umbilicus, and the stomach region is explored. The great omentum is pushed to the left, the first coil of jejunum is identified in the manner described and is then drawn forwards in front of the transverse colon, so that it can be brought in contact with the stomach. The anterior wall of the latter is brought out of the wound, as well as the piece of jejunum, and both are packed round with sponges or gauze compresses. Care is taken that there is no strain put upon the jejunum when it is drawn into place. If the loop of jejunum be too short it acts as a strap across the transverse colon, and drags upon the stomach. The selected coil of jejunum is held by an assistant, whose fingers act as compressors. No clamps are needed. The stomach also is drawn into the parietal wound, and the point at which it is to be opened decided upon. A linear incision, one and a half inches in length, is now made through the outer coats only of both jejunum and stomach, the incisions being exactly opposite to each other. With a needle threaded with fine silk a continuous suture is passed parallel to the two incisions and posterior to them; this is knotted at each end, and the two surfaces

of stomach and jejunum are thus brought closely together. The free ends may be left long and secured with forceps. The suture should take a firm hold, going as deeply as the sub-mucous layer in each viscus. The intestine is now opened by completing the incision already begun and by cutting through

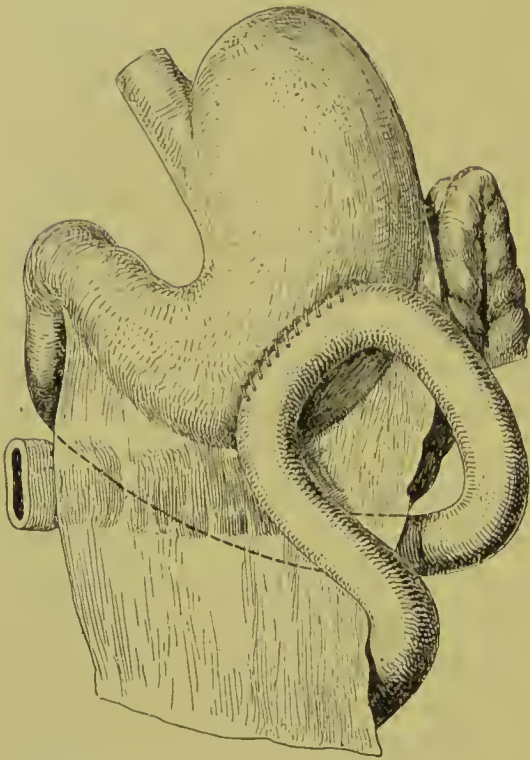


Fig. 408.—ANTERIOR GASTRO-JEJUNOSTOMY.
(From Hartmann's "Chirurgie Gastro-Intestinale").

A loop of the jejunum is drawn in front of the great omentum and transverse colon, and is fixed to the anterior wall of the stomach. The opening between the two has been made, and the final continuous suture is shown drawing the outer coats of the two viscera together.

the mucous coat; this is best done with a tenotome and completed with scissors. The same step is carried out in the stomach, any gastric juice that escapes being at once mopped up with sponges. Any bleeding vessel should be seized with a Wells's forceps. A second line of continuous suture is carried through the posterior side of the opening—*i.e.* the side already dealt with—the needle traversing all the coats. It is often advisable to cut away with scissors the protruding edges of the mucous membrane. If a Robson's bobbin be employed it is now introduced, and the line of continuous suture carried around in front of it,

being firmly secured at each end by a knot. It only remains to make a third line of suture through the outer coats in front of the opening—*i.e.* to cover in the continuous suture just made. In cutting through the stomach and intestine walls some small arteries are sure to bleed, but they rarely require ligature, as clamping with Wells's forceps for a few minutes suffices to stop them. All sponges being counted and removed,

the sides of the abdominal wound are held forward so that the stomach and the jejunum slip back, and the wound is closed in the usual manner.

The method of suturing employed in the above operation will perhaps be rendered clearer by recapitulation. The two linear incisions made through the outer coats only of stomach and jejunum should be of exactly the same length; they mark the size and position of the anastomotic opening. The first row of stitches, which take a firm hold of all but the mucous coats, fix the opposite surfaces of the two viscera together behind the linear incisions; it saves time to use the continuous suture, knotting it after every three or four insertions of the needle. Many operators employ interrupted sutures. The next step is the completion of the opening into both stomach and jejunum in front of the row just described. If the mucous membrane bulges, any redundant portion is cut away with scissors. The second row of sutures brings the edges of the opening into stomach and jejunum respectively into close contact all round; here also the continuous method is the best and most rapid. The third row, which is practically a continuous Lembert suture, is shown in Fig. 408; it traverses only the outer coats. Two or three additional Lembert's sutures at either end may be required to take off the strain on the others, and to prevent sharp kinking of the intestine.

(2) **Posterior Gastro-jejunosomy by Suturing.**—This method differs from the preceding in the following respects:—The transverse colon and great omentum are turned upwards, and the under layer of the mesocolon is exposed. An aperture is made in the latter, avoiding the branches of the superior mesenteric artery and vein. Through this aperture the posterior wall of the stomach is drawn, a sufficient area being exposed in which to make the anastomosis. Two or three sutures are so applied as to fix the edges of the opening in the mesocolon to the stomach wall. These sutures should only penetrate the outer coats of the stomach. The jejunum, having been picked up and brought into position, is then sewn obliquely to the stomach in precisely the same manner as

already described (Fig. 409). Robson's bobbin is often used to facilitate the suturing.

(3) **Gastro-jejunostomy by Murphy's Button.**—The chief points in this method have been referred to and illustrated in the section on Suture of the Intestine (page 292 *et seqq.*). Care should be taken to place the heavier part of the



Fig. 409.—POSTERIOR GASTRO-JEJUNOSTOMY.

(From Hartmann's "Chirurgie Gastro-Intestinale").

The transverse colon is raised and part of the stomach has been drawn through an aperture made in the transverse mesocolon. The loop of the jejunum has been fixed to the stomach obliquely, the opening made between the two organs is being evenly secured all round by a continuous suture of silk.

button in the intestine, so that when it works loose it may not fall into the stomach. It is, however, to some extent a matter of chance into which viscus the button travels.

A few extra Lembert's sutures should be inserted to hold the two viscera together in the neighbourhood of the opening. This applies to all three methods described, as they not only render the apposition more secure and the chance of leakage less, but they also prevent kinking of the intestine.

The one great advantage of the button is the rapidity with which the operation can be performed. If the stomach and

jejunum are already in place in the wound, the operation of gastro-jejunosomy can be completed in some eight minutes.

The button may fall into the stomach and remain there for weeks or months. I have known the button to be passed *per anum* nine months after the operation. The button has caused trouble from retention. In one instance I had to remove the button by gastrotomy eleven months after it had been employed in a case of fibrous stricture of the pylorus. It caused no gastric symptoms, but led to an abscess which opened near the original scar. As soon as the abscess was dealt with I reopened the abdomen and removed the button through the posterior wall of the stomach, the anterior wall being adherent.

The **after-treatment** is much the same as that observed after pylorotomy. Food is given by the mouth as soon as the vomiting has passed off, and as soon as it is well borne. Solid food has been given as early as the sixth or eighth day. The treatment by starvation is not to be commended. The recovery of some of the patients has been remarkably rapid.

The bile-containing fluids in the intestine are apt to flow into the stomach, where they excite vomiting. To avoid this the patient should not be kept flat in bed during the forty-eight hours following the operation, but should be raised with pillows as soon as possible.

Comments on and Modifications of the Operation.—

At first the anterior method was alone used, but posterior gastro-jejunosomy has come more and more into favour, and by some surgeons is always employed. The reasons given for the preference of the posterior method are (1) the opening is lower down in the stomach; (2) the commencement of the jejunum is opened instead of a part of the gut several inches from this point: hence regurgitation is less common, and the stomach evacuates itself more readily; (3) there can be no interference with the transverse colon by the jejunal loop, and no risk therefore of intestinal obstruction.

On the other hand, anterior gastro-jejunosomy has given excellent results in many cases, and it is somewhat the easier to perform.

The question is hardly settled yet, but on the whole the posterior method is to be advised whenever practicable. The extent of the eaneer will often determine the surgeon's decision. As to whether Murphy's button or simple suturing should be employed, it may be noted that with the button the operation can be effected in less than half the time that suturing takes. Hence, if the patient is not in a condition to bear more than a short operation, the button should certainly be used.

On the other hand, suturing has given a larger percentage of recoveries, it leaves no foreign body behind which may perhaps remain in the stomach, there is little or no tendency for the opening to contract (this has been repeatedly observed with the button), and many surgeons, after a trial of the other method, have returned to simple suturing. The rapidity with which the latter can be performed largely depends on practice and the use of the continuous suture instead of interrupted stitches. In some of the earlier cases it is recorded that two, three, or even more hours were taken. A surgeon with experience of the operation need rarely spend an hour over the operation from the first step to the last.

Prof. Koehler of late (1903) has suggested an interesting modification with the view of preventing return of bile, etc., into the stomach after gastro-jejunostomy. In some five cases he has divided the peritoneum above and to the right of the first part of the duodenum, and so been able to push inwards the latter sufficiently to establish the opening between the stomach and the duodenum above the orifice of the bile-duct. The method is for obvious reasons hardly likely to be applicable to many cases of gastric eaneer.

The chief causes of mortality directly following gastro-jejunostomy are :—

1. Hæmorrhage into the stomach. This has occasionally followed both suturing and the use of Murphy's button. To prevent this, if any vessel of unusual size is cut across during the operation it should certainly be tied with silk.
2. Collapse and exhaustion. This may be due to the operation having been postponed too long, or to its

- being too protracted. Strychnia injections and giving nourishment by the mouth as soon as possible are the best means of combating it.
3. Peritonitis. This is nearly always due to leakage at the site of the orifice, and is probably more apt to occur when Murphy's button has been employed.
 4. Kinking of the gut.
 5. Persistent vomiting. Elevation of the trunk and washing out the stomach with warm water should be employed if sickness comes on.

What is the Mortality Attending Gastro-jejunostomy?

—It is difficult to obtain a candid and fair answer to this question. Patients for whom it is done in hospital are usually suffering from advanced cancer of the stomach, and the mortality amongst them is higher than it is amongst private patients who are seen at an earlier stage of that disease or amongst those suffering from chronic gastric ulcer. The published statistics of any individual surgeon are, moreover, usually drawn up with a generous hand. The following statement includes all cases of gastro-jejunostomy done in the London Hospital during the ten years 1893-1902. In the great majority it was performed for pyloric carcinoma. By "recovery" is meant that the patient was able to leave the hospital—the only real test. Out of a total of 61 cases, 43 died, and 18 (about 30 per cent.) recovered. The cases in which Murphy's button was employed (27 in number) resulted in 8 recoveries—*i.e.* 29 per cent. Those treated by suturing alone (29 in number) resulted in 10 recoveries—*i.e.* 34 per cent. In 5 cases, all fatal, the exact method employed is not stated. These statistics reveal how high the mortality following the operation is in cases of malignant disease, although it must be largely ascribed to the cachectic condition of the patients at the time it was done. They indicate, moreover, that direct suturing is safer than is the use of Murphy's button.

Mr. Page collected thirty-eight published cases of gastro-jejunostomy (by suturing and the anterior method). Fifteen of these resulted in death, twenty-three in recovery.

When the operation is done for non-malignant stricture, or for chronic ulcer, the direct mortality is very much lower than is indicated above, and is probably under 10 per cent.

7. OPERATION FOR GASTRIC ULCER AND ITS RESULTS.

Circumstances of the Operation.—The chief indication for operation in cases of simple gastric ulcer is the occurrence of perforation with the escape of stomach contents into the peritoneal cavity. This will therefore be considered first. As soon as it is recognised that such perforation has occurred the abdomen should be opened in the middle line above the umbilicus, with the twofold object of cleansing the peritoneum and sewing up the aperture in the stomach. The less the delay the greater will be the chance of recovery. This is well brought out by the statistics given by Robson and Moynihan ("Diseases of the Stomach," 1902, p. 161). When the operation was undertaken within twelve hours of the probable onset of perforation, about three out of four cases recovered; between twelve and twenty-four hours, only one in three lived; whilst the mortality of those operated on thirty-six to forty-eight hours after perforation rose to 100 per cent. Much will depend, however, on the degree of irritation produced by the extravasated fluid; in some cases localised peritonitis shuts off the mischief, and an operation which consists in the free drainage of a subdiaphragmatic abscess may be successful many days after the actual perforation. On the other hand, if the stomach is full of food and digestion is in active progress when the gastric ulcer gives way, an intense general peritonitis may be set up and be accompanied with such a degree of shock that the case is hopeless from the first.

It may be noted that rupture of a pyo-salpinx, or the bursting of an abscess which had been localised around the vermiform appendix, may give rise to the same symptoms as those of perforation of a gastric ulcer. This is of importance, since in the two former conditions the surgeon should explore below the umbilicus, in the latter the incision is made above. If the history can be obtained of prolonged dyspepsia and

persistent epigastric pain (worse after meals), the probabilities are in favour of gastric ulcer. Hæmatemesis is a most uncertain guide, as in many cases of gastric ulcer there is no history of its occurrence. Abnormal resonance over the liver is present in about 50 per cent. of the cases of gastric perforation. The patient should be given the chance afforded by operation, unless when seen by the surgeon she is moribund from heart failure, or unless, with the lapse of time, general peritonitis has led to extreme abdominal distension. Before operating, the shock should be combated by injections of strychnia, by enemata of brandy-and-water, hot-water bottles and blankets, etc. It should not be forgotten that after the first severe symptoms the patient may rally and a deceptive lull of some hours' or even days' duration occur. This is the very time for operation, and in no way a reason for its postponement.

Steps of the Operation.—The skin having been cleansed with an alcoholic solution of an antiseptic as thoroughly as time will allow, a free incision is made in the middle line. Thin fluid mixed with flakes of lymph (which form with extraordinary rapidity) or with particles of food will probably escape as soon as the peritoneum is incised. Stitch retractors or pressure forceps are used to hold the edges of the wound forward, whilst the operator with a large soft sponge rapidly clears away all extravasated fluid about the stomach, and brings the latter into view. It may be necessary to break down adhesions between the stomach and liver, and to keep the latter organ out of the way by sponge pressure or the hand of an assistant. In the same way coils of intestine which tend to protrude should be kept aside by flat sponges. It is fortunate that the common site for perforation is one of the most accessible parts of the stomach. In 60 or 70 per cent. of the cases the opening will be found on the anterior wall near the lesser curvature and nearer the pylorus than the cardiac end. The hole may be very small, and usually the stomach wall for some distance around it is thickened and hard.

If the perforation is situated under the left side of the diaphragm it may be necessary to cut across the rectus muscle in order to expose it. In this case the superior epigastric

artery should be at once clamped. A perforation close to the cardiac end is extremely difficult to expose. Supposing the surgeon has examined the whole of the anterior surface without finding the ulcer, and yet the nature of the extravasation makes it certain that the alimentary canal is leaking high up, he should carefully examine the duodenum, and so far as is possible the posterior surface of the stomach. A perforation of the duodenum should be dealt with in the same manner as one of the stomach. Perforations on the posterior wall of the stomach are exceedingly difficult to close. Very few cases of suture of perforations on the posterior wall have been recorded. I (J. H.) happen to have had one such, which ended successfully. In this case the extravasated fluid was noticed to be oozing from the foramen of Winslow, *i.e.* out of the lesser sac, an aperture was made in the lesser omentum, and a perforation found opposite the pancreas. The assistant's hand being used to turn the stomach round, and so expose the ulcer, the latter was excised, a row of sutures was inserted, and the patient made a good recovery. It has been recommended that the posterior surface should be reached through an aperture made in the gastro-colic omentum, *i.e.* from below, but experience in the case mentioned leads me strongly to advise the upper route through the lesser omentum.

It may be that the patient's condition does not allow of time being spent over suturing the stomach wall, or the latter may be so friable that any stitches inserted at once cut out, but generally a row of Lembert's or other sutures can be safely introduced. If the ulcer be small, it may be excised with advantage. Occasionally a piece of omentum (or, in a successful case reported by Mr. Heaton, a piece of reflected falciform ligament) can be sewn down over the perforation when the latter cannot itself be closed by stitches.

The next step is to cleanse the peritoneal cavity, and this is best done by large moist sponges. Particular attention should be paid to certain regions, namely—

1. The cavity of the pelvis:
2. Each renal fossa.
- 3 The subdiaphragmatic spaces on either side.

The subdiaphragmatic spaces are especially liable to be overlooked. It will be understood that to reach the pelvis the wound may have to be considerably enlarged, and some even advocate that the intestines should be drawn outside the abdomen in order to cleanse them. This, however, involves increase of shock and further time, and it is important that the surgeon should work with all possible rapidity.

Irrigation with warm water is recommended by some. On the whole, irrigation combined with sponging seems to give the best results. Before closing the abdomen the surgeon should provide for drainage of the stomach region by tubes and gauze drains, particularly of the left hypochondrium. It is often advisable to drain each loin as well as Douglas's pouch by tubes brought through counter-openings.

After-treatment.—The shock of the operation is best met by free intravenous saline infusion and strychnia injections. The patient's pelvis should be raised and the head kept low. For some days after the operation feeding with peptonised milk and meat juice should be carried out *per rectum*. If the perforation has not been closed by sutures, or if it leaks subsequently, the region of the stomach should be gently irrigated every day, and a two-way drainage-tube is convenient for the purpose. Occasionally a secondary abscess develops high up under the diaphragm and may need a posterior opening.

Proportion of Recoveries.—It is probable that of all the cases operated on, not more than 30 per cent. recover, though it would be easy to quote more favourable statistics. As already mentioned, the earlier the time at which the operation is undertaken the greater is the patient's chance. The mortality attending perforation of a duodenal ulcer is even higher than that of gastric perforation, and comparatively few cases have been operated on successfully. For a record of cases, see Mr. Moynihan's paper, *Lancet*, December 14, 1901. The operative procedure is similar to that employed in gastric perforation from ulcer.

Operation for Gastric Ulcer which has not Perforated.—In view of the many complications following gastric ulcer, the considerable mortality due to hæmatemesis from the ulcer

(about 10 per cent. of all cases), and the still higher mortality following perforation from this cause, it is reasonable to expect that early operation will be more resorted to. The object of such early operation is a direct and curative one, and is accomplished either by (1) excision of the ulcerated part of the stomach wall, followed by careful suturing of the wound; (2) ligature of the bleeding point after opening the stomach; or (3) gastro-jejunostomy to give rest to the stomach and promote healing of the ulcer.

Gastro-jejunostomy has been attended with considerable success in the treatment of cases of persistent or recurrent hæmatemesis.

It should be noted that in some cases of severe or even fatal hæmatemesis which have been diagnosed as gastric ulcer no appreciable ulcer has been found after a thorough search, either during operation or at the post-mortem examination. These cases are, however, quite the exception.

DUODENOSTOMY AND JEJUNOSTOMY.

These operations, which may be noticed here as a pendant to the present chapter, consist, as the names imply, in the establishing in the duodenum or jejunum of an artificial opening or stoma, through which food can be introduced. The measures have been carried out in cases of stenosis of the pylorus of various kinds.

Duodenostomy was first performed by Langenbüch in 1879. The operation has been carried out in two stages. In one the bowel is attached to the wound in the parietes; in the other it is opened.

The operation has been performed several times, but in few instances has the patient survived more than a few days.

In jejunostomy the artificial opening is made lower down in the intestine. This operation has not been performed many times, but it has been attended by some degree of success. It is claimed for this measure—when compared with gastro-enterostomy or pyloric resection—that the operation is very simple, that it is readily carried out, and, above all, that it may be very quickly performed. There is no risk of extravasation from the stomach, or of kinking of the bowel; the colon cannot be compressed, as has been the case in some of the examples of gastro-enterostomy; and more complete rest is given to the malignant growth.

The stomach is, however, excluded from the digestive process, and unless the artificial opening be made quite high up in the jejunum, the probability of gradual starvation is considerable. The stomach is not relieved, and no food can be taken by the mouth.

Moreover, the fluid in the duodenum and upper jejunum is very irritating to the skin, and it is more difficult to prevent it from escaping than in the case of gastrostomy.

For these reasons the operations are hardly worth describing.

CHAPTER XIV.

OPERATIONS ON THE LIVER.

Anatomical Points.—The liver is moulded to the arch of the diaphragm. Its convex surface is protected on the right side by the ribs, from the seventh to the eleventh inclusive, and in front by the xiphoid cartilage and the costal cartilages, from the sixth to the ninth inclusive, the diaphragm being interposed.

The liver extends to the left about one and a half to two inches beyond the left margin of the sternum. In the middle line the liver lies close beneath the skin, in front of the stomach, and reaches about half way between the xiphoid cartilage and the navel.

The lower edge, as it crosses the subcostal angle, is represented by a line drawn from the ninth right to the eighth left costal cartilage (Quain). In the erect posture the lower edge on the right side is about half or quarter of an inch below the margins of the costal cartilages. In the recumbent position the liver ascends about an inch, and is entirely covered by the costæ, except at the subcostal angle. It descends also on expiration, and ascends on inspiration; and this disposition to movement must be allowed for when it becomes necessary to stitch a wound in the liver to the parietes.

“The extent of the liver upwards, if traced on the surface of the body, is indicated by a line crossing the mesosternum close to its lower end, and rising on the right side to the level of the fifth chondro-sternal articulation, and on the left to that of the sixth” (Quain).

The right lung lies in front of the liver, as far down as the upper border of the sixth rib, in the nipple line, and the heart as far down as the fifth interspace on the left side.

Behind, the liver comes to the surface below the right lung at a part corresponding, both in position and width, to the tenth and eleventh dorsal vertebræ. On the extreme right the liver descends to the level of the second lumbar spine (Fig. 415).

It is needless to say that the relations of the viscus may be greatly altered by diseased conditions, especially by such as are attended by enlargement of the organ, or the development of abscesses or tumours within its substance.

The gall-bladder, when moderately distended, is pear-shaped, and measures about 10 cm. in length and 3 cm. in width at its fundus. It is capable of holding about 20 c. cm. of bile.

The fundus touches the abdominal wall below the free end of the cartilage of the tenth right rib, and near the outer border of the right rectus muscle.

The fibrous coat of the gall-bladder is thin, but is remarkably firm and tough.

The cystic duct is about one inch in length, and turns a little towards the left. It joins the hepatic duct at an acute angle. The common bile-duct measures about three inches (Fig. 412). It descends in the lesser omentum in front of the portal vein, and to the right of the hepatic artery and its gastro-duodenal branch. It enters the right pancreatico-gastric fold behind the first part of the duodenum, and is crossed by the pancreatico-duodenal artery as it approaches and pierces the second part of the duodenum about its middle.

Operations.—The following operations will be described in this and the next chapter :—

Operations on hydatids of the liver.

Operations on hepatic abscess.

Hepatotomy.

Cholecystotomy.

Choledochotomy.

Cholecystectomy.

Cholecystenterostomy.

OPERATIONS ON HYDATIDS OF THE LIVER.

The pathology of the cyst-wall in a case of hydatid disease, whether of the liver, lung, or other organ, should be clearly

understood, as proper surgical treatment depends upon this knowledge. The true hydatid membrane or endocyst is laminated, non-vascular, and from its inner surface are developed the brood capsules or daughter cysts. In exceptional cases the latter are not formed, then the term acephalocyst is employed; but the hydatid membrane or wall in this case has all the other features of the more common proliferating cyst. The endocyst in the normal condition adheres but slightly to the ectocyst, which is a layer of fibrous tissue surrounding the true hydatid membrane. The surgeon's aim in dealing with a hydatid cyst should therefore be—

1. To expose the ectocyst and, by incision if necessary, to fix it to the parietes by sutures.
2. After incision of the ectocyst to detach the endocyst, and if possible *to remove it entire with the daughter cysts.*
3. If, as often occurs, the endocyst breaks during the operation, or has already become inflamed or degenerated, the surgeon should remove by irrigation, etc., all the fragments of membrane and cysts that he can get away.
4. If the entire hydatid membrane has been extracted, and especially if the case is one of acephalocyst, nothing further remains to be done than to insert a drain, and to observe rigid asepsis in the few dressings that will be required before the cavity closes up.
5. If, on the other hand, owing to previous suppuration, etc., it is impossible to remove the entire cyst, and daughter cysts remain, the operator should provide for free drainage. Daily irrigation with sterile warm water should be practised, and any fragments or cysts that present at the aperture should be assisted to make their exit.

It will be noted that the essential thing during the operation is to remove the endocyst whilst the fibrous layer outside this is quite harmless, and a futile attempt to dissect it out from such a vascular organ as the liver would certainly be attended

by dangerous hæmorrhage. The fingers or a broad sponge-holder serve best for grasping the membrane, which can often be thus twisted or folded on itself so as to facilitate its removal.

The treatment outlined above is the only satisfactory one for hydatid disease, whether of liver, lung, or other viscus.

Sometimes, besides the main cyst operated on, there may be a number of others disseminated through the same or other organs. This occurred in one case of hydatid of the lung operated on at the London Hospital—one main cyst with daughter ones was removed after partial excision of ribs, etc. The patient died, and upwards of a hundred small cysts were found scattered through both lungs (J. H.).

Aspiration or galvano-puncture as a curative measure should not be resorted to. Even when used for the purpose of diagnosis, aspiration is not without risk, unless the tumour has already been exposed, and the surgeon can at once proceed to removal of the cyst.

Amongst the accidents that have followed puncture or aspiration in cases of hydatid disease of the liver (real or suspected) the following may be enumerated:—

1. Fatal syncope (many instances).
2. Severe toxæmia from rapid absorption of the hydatid fluid.
3. Peritonitis from leakage of the cyst, sometimes fatal.
4. Puncture of the portal or other large vein in the liver.
5. Wound of and leakage from the gall-bladder into the peritoneal cavity.

The injection of bichloride of mercury or of iodine solution into a hydatid cyst of the liver is dangerous; as a curative measure it is most uncertain.

Site of the Operation.—In the great majority of cases the cyst can be reached from below the costal margin—in fact, it often pushes forward the abdominal wall. Should it mainly ascend beneath the diaphragm, one or two of the lower ribs should be resected.

Treatment by Incision.—The operation may be performed in one or in two stages.

The first deliberate operation upon hydatids of the liver was performed by Tait in 1882.

He demonstrated the possibility and also the safety of the method of operation in one stage.

The subject has been very fully dealt with by Dr. W. Gardner, of Adelaide, and others, in the *Transactions of the Second Inter-Colonial Medical Congress* (1889).

1. *Operation by One Stage.*—This measure is termed by some hepatotomy. It involves the opening of the abdominal cavity, the incision and evacuation of the hydatid cyst, and the suturing together of the margins of the hepatic and parietal wounds.

The skin having been well cleansed, an incision is made over the most prominent part of the tumour. The wound will probably be longitudinal, *i.e.* in the long axis of the body. It should fall upon the abdominal part of the swelling—that is to say, should the most prominent portion of the tumour present in an intercostal space, it should not be incised there, owing to the difficulty of ensuring adequate drainage when the fluid is evacuated between two ribs.

The knife is carried through the parietes, and an examining finger is cautiously introduced into the abdominal cavity. The incision should at first be only about one inch and a half in length. It is extended in whatever direction appears most advantageous after the preliminary digital examination has been made.

The incision may fall upon a spot where the liver is already adherent to the parietes. If so, it is well. Should the digital exploration show that the viscus is adherent to an adjacent part of the abdominal wall, then the incision may be carried in that direction; or another and entirely distinct incision may be made over the adherent area.

In the majority of the uncomplicated cases of hydatids there are no adhesions.

The liver is exposed, and the most convenient spot for evacuating the cyst determined upon. This area is circumscribed by gauze or Turkey sponges, which are carefully wedged

in all round, so as to prevent the escape of any fluid into the peritoneal cavity.

It will now be convenient to introduce the largest needle of an aspirator, and to withdraw enough of the contents of the cyst to remove all tension. The more fluid removed by the cannula the better, so long as too much time is not expended in the process.

The cyst is drawn as far forwards as possible, the needle puncture is enlarged with a scalpel, and the left forefinger is at once introduced into the opening. This digit serves to act as a plug, and at the same time it is a means of hooking or dragging the cyst forwards, so as to bring its opening well into the parietal wound.

The margins of the cyst wound should now be seized by two or more pressure forceps, and by means of these the lips of the cyst wound are drawn forwards, and are kept well approximated to the parietes while the main bulk of the contents of the cyst is escaping. By this means the whole cyst may often be evacuated without any fluid entering the peritoneal cavity.

Hæmorrhage from the hepatic incision may be arrested by sponge pressure, or by pressure forceps; or, failing these, by a continuous suture of fine catgut.

The cyst is now so far empty that no more fluid spontaneously escapes. The opening in the cyst is enlarged as far as is required, and its margins are held by means of additional pressure forceps, as one would hold the mouth of a bag. The finger is introduced, and the interior of the cyst is examined. If possible, the main endocyst should be removed entire by gently detaching it, grasping it with sponge-forceps, and folding it up by a rotation of the latter. In this way, aided by the fingers of the left hand, the cyst wall may be extracted. If, however, suppuration has occurred, or there are great numbers of daughter cysts, the surgeon will trust mainly to free irrigation and the use of mounted sponges. The irrigation should be done with sterile water at a temperature of about 100° F. The whole of the interior of the cyst should be well but gently cleared out.

The time is now come for uniting the margins of the hepatic wound to the margins of the parietal incision.

The edges of the cyst wound are still held with forceps, and into the mouth of this wound a sponge is wedged. The sponges which have been packed around the operation area are now removed, and are carefully counted, as one or more may readily slip out of sight. The peritoneal cavity is cleansed by means of sponges in holders in the usual way (page 235), and to this part of the operation special attention must be paid.

The margins of the opening in the cyst are now sutured to the edges of the parietal wound. The stitches may be interrupted, and of silkworm-gut closely applied; or they may be continuous and of silk. Care must be taken that peritoneum is brought in contact with peritoneum. A curved Hagedorn's needle will be found useful in this part of the operation. If the cyst wall have been firmly secured, the cavity may be further evacuated and cleared out by means of sponges in holders; but all such manipulations must be conducted with the utmost gentleness.

A large drainage-tube is introduced and is fixed in position. For large cysts I use a tube with a diameter of one inch. It is useless to attempt to drain a cavity which has contained some pints or quarts with a tube having a lumen of one quarter of an inch.

The wound is dusted with iodoform, and covered with a large absorbent dry dressing of wool, gauze, or Tillmann's linen. It is secured in place by means of a many-tailed bandage.

The *after-treatment* consists of the frequent washing-out of the cyst cavity with some antiseptic solution, and the maintenance of the most absolute cleanliness and the most perfect drainage. An irrigator which provides a large stream is essential; and the cleansing solution may be composed of carbolic acid, corrosive sublimate, or iodine in very weak aqueous solution.

2. *Operation by Two Stages.*—This operation aims at securing adhesion between the parietal peritoneum and the hepatic peritoneum over the seat of puncture.

The procedure to effect this end constitutes the first stage

of the operation. The second stage is undertaken after an interval of some days, and is simply represented by the incising of the now adherent cyst.

It is claimed for the measure that it does away with the risks attending the escape of blood or cyst fluid into the peritoneal cavity.

The operation in two stages has been strongly urged by Volkmann, and is often known by his name.

The parietal incision is made, and the parietal peritoneum opened. The cut edges of this part of the serous membrane may then be attached by a few points of suture to the margins of the parietal wound. A dressing of gauze is then applied, so firmly as to keep the abdominal wall as far as possible in contact with the liver.

Some surgeons prefer to secure the peritoneal covering of the liver to the parietal peritoneum by suture points of fine catgut. These are passed by means of a full-curved Hagedorn's needle. Mr. Godlee advises that they be passed pretty deeply into the substance of the liver, and that the stitches be in a double row.

The cyst is incised at the end of three, four, or seven days, no anæsthetic being, as a rule, required.

The exact method adopted by Mr. Godlee is illustrated by the following account of the procedure carried out in a case of abscess of the liver (*Brit. Med. Journ.*, January 18, 1890, page 123):—"I made a vertical incision about one inch and a half below the margin of the ribs, a little above the most prominent part of the swelling, *i.e.* about the middle (from side to side) of the rectus, and after dividing the abdominal wall, found no adhesions at the part of the liver exposed. I therefore separated the rectus from the posterior layer of its sheath, so as to expose a portion . . . [See Fig. 410]. Then with Hagedorn's needles two rows of stitches were applied—the outer being interrupted and of silk [*e*], the inner continuous and of catgut [*f*]. The needles went right into the liver substance, and the closure was, as far as could be ascertained, complete." In this particular case the abscess was opened at once.

Should it be found, on examination, that stitches will not

hold, two courses are open to the surgeon. In the first place he may pass a stitch on each side through the peritoneum and muscle only, and keep the sides of the incision apart by a tampon of sterilised gauze.

If adhesions are secured, the cyst is opened later; but if no adhesions form, then the following method may

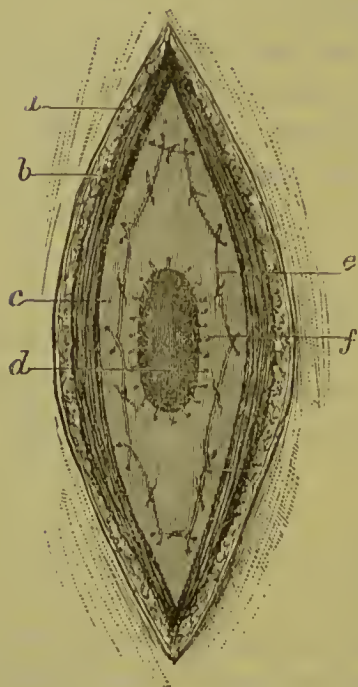


Fig. 410.—METHOD OF ATTACHING THE LIVER TO THE PARIETES. (*Godlee.*)

a, Subcutaneous fat; *b*, Rectus; *c*, Sheath of rectus; *d*, Liver; *e*, Interrupted suture; *f*, Continuous suture.

be adopted:—The cyst having been exposed, and the abdominal walls pressed against it by means of a circle of sponges, the operator—who must be rapid in his movements—plunges in his knife, and cuts downwards sufficiently to enable two fingers of his left hand to be introduced. He then, by the side of his fingers, inserts four cardinal stitches, and ties them. The remaining steps of the operation are similar to those already described.

Observations and Comment upon the Two Methods.—Hydatid cysts of the liver have been successfully evacuated through the pleural cavity. This is illustrated by a case of Mr. Edmund Owen's. The incision was made in one of the right intercostal spaces; the pleura was sound and free from adhesions. The

diaphragm was incised, the cyst exposed, and the tension upon its walls relieved by aspiration. The face of the sac was then “drawn through the diaphragm, and across the shallow pleural cavity to the skin wound, to which it was secured by four hare-lip pins. Thus the pleural wounds were placed in mutual contact.” On the fourth day the pleural surfaces were found to be firmly adherent; the cyst was then incised, and twenty-eight ounces of fluid were evacuated. No part of a rib was removed. The patient made a good recovery (*Clin. Soc. Trans.*, vol. xxi., page 78)

In cases such as this where the cyst bulges upwards into the thorax it will usually be found best to excise subperiosteally two or three inches of the ribs immediately over the greatest projection. The two surfaces of the pleural cavity should be stitched together if possible before incising the diaphragm or cyst wall. The diaphragm itself may be much thinned or perforated by the cyst wall, and it is by no means easy to recognise.

Mr. Thornton has reported a case in which a hydatid cyst of the pelvis was successfully drained through a like cyst in the liver which had been opened in the usual way. In another of his cases a large hydatid cyst in Scarpa's triangle communicated with a large hydatid of the liver, and was drained through the abdominal sac (*Brit. Med. Journ.*, January 5, 1889, page 5).

In exposing the cyst by the direct method, vascular omentum has more than once been found to be adherent over the tumour, and to have hampered the operator's movements.

(For an account of the removal of hydatid cysts *en masse*, see page 442.)

Of the two methods above described, the direct method by one stage is without question the more satisfactory, and carries with it no particular or unnecessary risk. In other words, it has not been shown that the precaution which is characteristic of the method by two stages is well founded. The risk attending the escape of hydatid fluid into the peritoneal cavity has been much exaggerated.

This latter method somewhat narrows the area of the surgeon's movements; when no sutures are applied, the extent and the stability of the adhesions are subject to variation, and those which are formed may not suffice to completely shut off the peritoneal cavity. The surgeon is acting a little in the dark. The attachment of the cyst wall to the parietes is not at once so firm as that which is secured by sutures, and the complete clearing-out of the contents of the cyst cannot be so safely effected. Above all, much time is lost. This may be a matter of little moment in the case of a hydatid cyst, but it may be of paramount importance in the case of a hepatic abscess.

If care be taken during the one-stage operation, the risk of the escape of septic fluid into the peritoneal cavity is reduced to a minimum; and it must be distinctly understood that that risk is not done away with entirely in what is known as Volkmann's operation, especially when the second stage is carried out at so early a period as the third or fourth day, and no sutures are employed.

The direct operation by one stage may claim to be the more thorough and the more satisfactory, and to effect with more completeness the object the surgeon has in view.

It does not appear that these advantages are discounted by any unusual or special risks.

Mr. Godlee's method undoubtedly represents the best plan of carrying out the operation by two stages.

OPERATIONS ON HEPATIC ABSCESS.

What has been said about the treatment of hydatids of the liver may be said of hepatic abscess.

The abscess may be opened in three ways:—

1. **By Direct Incision**, when the abscess is "pointing," and when from the local tenderness, redness, and œdema it is evident that adhesions exist, and that the pus is close under the skin. This measure needs no further comment.

2. **By Incision and Drainage carried out at One Sitting.**—The method observed is precisely similar in all points to that already described in connection with hydatid cysts (page 444). If care be taken, and if the operation be conducted upon the lines laid down, there is little danger of any pus finding its way into the peritoneal cavity.

After the abscess has been evacuated, a gentle examination of its interior may be made, to ascertain if another abscess or cyst exists. The abscess cavity should be well cleared out by means of a soft sponge in a holder. The manipulation must be gentle, as the abscess wall is readily damaged, and bleeding ensues.

The after-treatment of the case is the same, the main points

being free drainage, frequent and free flushings-out with the irrigator, and the use of antiseptic measures throughout.

3. By Incision and Drainage carried out in two Stages.

—The proceeding employed is precisely identical with that already described in the account of hydatids of the liver (page 446). The best method is that employed by Mr. Godlee.

It has been pointed out that in dealing with the parasitic cyst, this method in two stages has no very great advantages. The same observations may apply to the case of hepatic abscess.

In addition to such objections as have been already formulated, the following may be noted :—

The adhesions which form, when no sutures are employed, may be insignificant, and may cover but a very small area. When the incision is made, that area may be easily transgressed.

Such adhesions cannot be firm until many days have elapsed, and this delay may prove a serious matter in the case of an abscess which is rapidly approaching the surface. Moreover, after adhesions have been secured, the abscess may show signs of pointing at another spot distant from the intended site of the incision. If Mr. Godlee's method be adopted, these objections cease for the most part to hold good. Mr. Godlee has shown that if the sutures are introduced in the manner described, the abscess may be at once opened, and all delay thus avoided.

Observations and Comment.—The method by free incision at one sitting offers undoubtedly the best means of dealing with hepatic abscess. Attempts to open the abscess by means of the actual cautery are to be condemned. The aspirator is only of use as an aid to diagnosis, and as a palliative means. Its employment has frequently compromised the success of a subsequent operation by free incision. There is nothing to recommend the common plan of tapping the abscess with a trocar, and of draining it through the cannula, or through a drainage-tube introduced in the place of the cannula.

The drainage thus secured is very inefficient, pus may leak out into the peritoneal cavity, the surgeon makes the thrust with the trocar in the dark, and important structures may be

punctured; the cannula may slip, and the measure would not meet a case where multiple abscesses exist. This apparently slight operation is—like most timid, speculative, and meddling half-measures—much more dangerous than the complete operation.

A valuable series of lectures on hepatic abscess, published by Mr. Godlee in the *British Medical Journal* for January, 1890, should be consulted by those who are interested in this branch of surgery. To the following points in these lectures especial attention may be directed:—

Mr. Godlee demonstrates by means of an illustrative case that even when an abscess is actually “almost pointing,” it is impossible to be certain that the liver will be found to be adherent. In the case quoted there were no adhesions.

Several of the cases illustrate the evacuation of the abscess through the chest wall. It is urged that in these cases the incision should be made below the normal limit of the pleura; but that if by chance either pleura or peritoneum be opened, the opening must be closed with a double row of stitches before the liver is incised.

In one illustrative case an exploring-needle had revealed the presence of deep-seated pus in the chest. An incision was made over the ninth interspace and a portion of the ninth rib was removed. The diaphragm was then stitched with some difficulty to the costal pleura, and the abscess was opened by cutting through the attached diaphragm. The patient made a good recovery.

In another case, in which the abscess was opened through the seventh intercostal space, profuse hæmorrhage occurred.

In a third case, in which an incision was made into the abscess through the seventh or eighth space at the lower part of the axilla, “terrific hæmorrhage” attended the enlargement of the opening into the abscess.

PARTIAL EXCISION OF THE LIVER (HEPATOTOMY).

In cases of lacerated wound of the liver a portion of the viscus has been sometimes excised with success, and occasionally

a new growth (adenoma, cystic-adenoma, or cancer) is so localised that its excision is justifiable. Mr. Mayo Robson has recorded several cases in which a malignant growth of the liver (sometimes including the gall-bladder) has been removed. Mr. W. W. Keen (*Boston Med. and Surg. Journ.*, April 28, 1892) has collected twenty cases of partial hepatectomy, several of them represented by examples of gumma, hydatid cyst, or constricted lobe. For neither of these can excision be really indicated, as other treatment would be safer and more appropriate.

In any suitable case the part excised should be in the form of a wedge, with its base at the free border of the liver, and after checking the hæmorrhage the two raw surfaces should be brought together by catgut or kangaroo tendon sutures, which take a deep hold of the liver substance. Pressure on either side of the section exerted by the assistant, who grasps the liver edge between finger and thumb, sponge pressure on the bleeding surface, direct ligature of cut vessels, and the use of adrenalin solution applied on a sponge, are all useful in checking the hæmorrhage before the sutures are tightened.

The thermo-cautery and the elastic ligature have also been used in some cases, but as both involve a sloughing surface in the liver, they should be avoided.

Dry sterilised or iodoform gauze should be packed round the wound of the liver, and ample provision allowed for drainage. The risk of ventral hernia is slight in this region.

The gauze should be removed in two to three days' time, and replaced by a smaller amount for drainage purposes.

Saline injections *per rectum* and strychnia may be given freely if the operation has been attended by much loss of blood. In several such operations hæmorrhage has been the direct cause of death.

CHAPTER XV.

OPERATIONS ON THE GALL-BLADDER AND THE MAIN BILE-DUCTS.

Anatomical Considerations.—The gall-bladder, pyriform in shape, lies in a shallow groove on the under surface of the liver, to which it is fixed in part by the peritoneum, by cellular tissue, and by numerous small blood-vessels. Its fundus or anterior end is usually covered wholly by peritoneum, and projects slightly at the anterior edge of the liver, being situated opposite the tip of the tenth right costal cartilage and immediately behind the abdominal wall. When distended, its fundus may be found much below this spot, to the right of the umbilicus, or even still lower. It has been mistaken, owing to this low position, for an ovarian cyst, as in a case recorded by the late Sir Spencer Wells.

When moderately full, the normal gall-bladder holds some 50 to 60 grammes of fluid, or about two ounces, but is capable of great distension. On the other hand, as the result of inflammation it is sometimes met with as an almost solid viscus with a very small cavity.

The long axis of the gall-bladder is directed upwards and backwards; in cases of downward displacement of the liver the direction may be almost directly upwards, and its axis will then form a sharp angle with that of the cystic and common bile-ducts (*see* Fig. 411).

When not displaced, the under surface of the gall-bladder rests on the pylorus or commencement of the duodenum and the hepatic flexure of the colon. In one out of every six cases there is a fold of peritoneum connecting it with the colon (the cysto-colic ligament).

The neck or narrow end of the gall-bladder is somewhat sinuous, curving from below upwards and from right to left, then directly backwards to the commencement of the cystic duct. This curved portion, like the greater part of the gall-

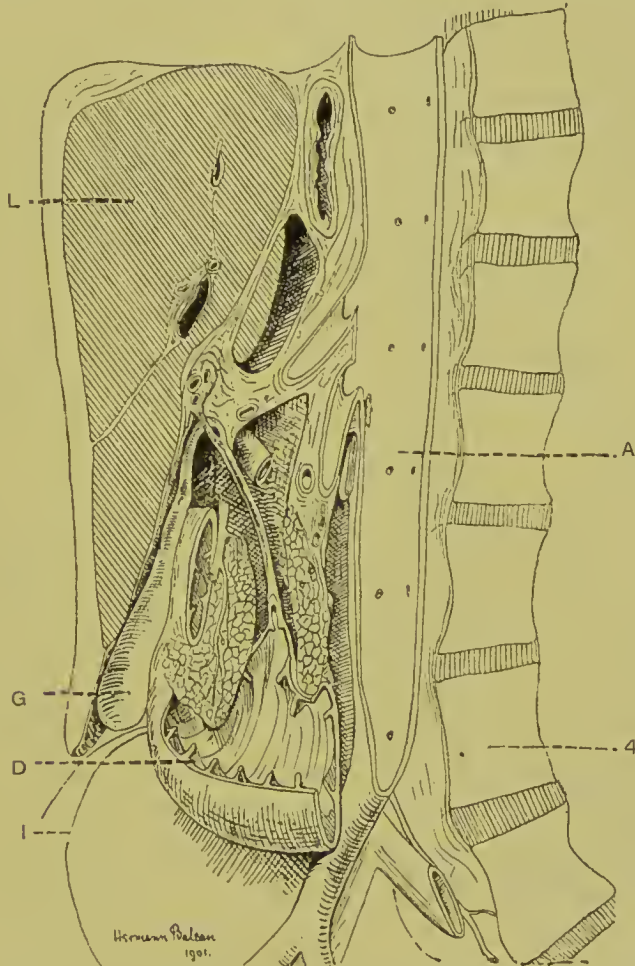


Fig. 411.—SECTION MADE OBLIQUELY DOWNWARDS IN A SUBJECT WITH NEPHRO- AND HEPATO-PTOSIS, TO SHOW THE DISPLACEMENT OF THE DUODENUM AND SHARP BEND OF THE BILE-DUCTS. (From a dissection by Dr. Keith in the London Hospital Museum.)

L, Liver ; A, Aorta slit open ; G, Gall-bladder ; I, Iliac bone ; D, Duodenum ; 4, Fourth lumbar vertebra.

bladder, is fixed to the liver by peritoneal folds. As seen in Fig. 412, at this point there are several valvular folds of mucous membrane corresponding with depressions on the outer surface, and beyond these the actual commencement of the cystic duct is narrowed.

Hence calculi are apt to become tightly impacted at this level, and hence it is impossible to pass a probe in most cases from a gall-bladder which has been opened into the common bile duct.

The vesical neck is in close contact with the right branch of the portal vein and below with the duodenum. The cystic



Fig. 412.—NORMAL GALL-BLADDER AND BILE-DUCTS.

a b, Gall-bladder; *c d*, Cystic duct; *e f*, Hepatic duct; *g*, Common bile-duct; *h*, Ampulla at duodenal orifice into which opens the pancreatic duct, *i*.

duct, from an inch to an inch and a half long, passes downwards in the gastric-hepatic omentum immediately in front of the portal trunk, to the right of the hepatic artery, being joined very obliquely by the main hepatic duct. The latter is somewhat larger, thicker, and longer than the cystic duct; it has no valvular folds. Hence calculi, though frequently met with loose in the hepatic duct, are rarely impacted there. The common bile-duct, about three inches in length, passes obliquely downwards, slightly backwards, and to the left, to open in common with the pancreatic duct into the second part of the duodenum. It lies at first for about one inch in the gastro-hepatic omentum just at its free or right border, and is crossed usually in front by the pyloric and right gastro-epiploic arteries. It is in this comparatively free portion, increased perhaps by drawing the first part of the duodenum downwards, that

the common bile-duct is mainly accessible

to the surgeon. Through an incision made in its long axis, after division of the peritoneum over it, suitable forceps may be passed down into the lower and protected portion of the duct. The latter runs behind the duodenum and in a groove of the pancreas, and is very closely applied to both organs. Before its narrow valvular opening into the duodenum (which is situated on the inner and posterior aspect of the latter just where its vertical or second portion ends) there is a slight dilatation (the ampulla of Vater).

Those who have only seen the common bile-duct in anatomical specimens can hardly realise the size and thickness it is capable of attaining owing to long obstruction. In many cases it has been found to have the diameter of the small intestine of an adult, and in one case operated on by Mr. F. S. Eve in the London Hospital, the dilated duct would have held one's hand.

The common bile-duct in its lower portion has occasionally been reached from an incision in the loin, but the ampulla is more easily approached from in front through an incision in the descending portion of the duodenum.

From the preceding it will have been noted that both where the cystic duct passes into the gall-bladder and at the lower end of the common bile-duct there are conditions favouring the impaction of gall-stones. It is well in operating to bear this fact in mind.

CHOLECYSTOTOMY.

By this operation is meant the making of an incision into the gall-bladder through a wound in the abdominal parietes.

Its chief indication is for the removal of gall-stones, whether impacted or not. It is also performed in cases of cholecystitis, in simple hydrops or distension with mucus of the gall-bladder—both conditions usually due to impacted gall-stone, but possibly to other causes, such as typhoid fever, hydatid cysts, or obstruction from growths at the transverse fissure. Cholecystotomy has frequently been performed in cases of jaundice due to malignant disease of the liver, gall-bladder, or pancreas. But the universal testimony is that under these conditions the operation only hastens the inevitable end, and that it should not be performed. The operation has been successfully carried out in certain cases of wound or perforation of the gall-bladder, and in one instance at least the gall-bladder was opened, and a temporary biliary fistula established, in order to relieve extreme congestion and enlargement of the liver (*Bull. de l'Acad. de Méd.*, November 4, 1890). The terms cholelithotomy and cholelithotripsy have been employed in instances in which gall-stones have been removed by cutting, or have been crushed *in situ*.

History of the Operation.—So long ago as 1733 Petit suggested the possibility of dealing with certain disorders of the liver by surgical means; and in a memoir published in 1743 he suggests that the distended gall-bladder should be relieved by puncture, and that stones lodged in that viscus should be removed by lithotomy (*Mém. de l'Acad. Roy. de Chir.*, 1743, page 163). Operations upon the gall-bladder were discussed in a casual and flighty manner during the early part of the last century, but it was not until 1867 that the modern operation of cholecystotomy was first performed. The operator was Dr. Bobbs, of Indianapolis. The patient recovered (*Trans. Indiana State Med. Soc.*, 1868, page 68). Dr. Marion Sims appears to have performed the second recorded operation (*Brit. Med. Journ.*, 1878, vol. i., page 811). The patient died, but Dr. Sims' paper may be said to have laid the foundation for the performance of the operation in Europe, since he detailed with great clearness and precision the various steps of the procedure. The first successful operation in England was performed by Tait on August 23rd, 1879 (*Med.-Chir. Trans.*, vol. lxxiii., page 17). Tait adopted Dr. Sims' plan, and in subsequent cases he further elaborated the operation and extended its possibilities. The operation as now practised may be said to be a most successful one, and the mortality is probably not higher than five or six per cent.

Hans Kehr, in a monograph on the subject (*Volkmann's klinischer Vorträge*, No. 225, 1898), records the results of 327 cases of gall-stone operated on by himself, with twelve deaths—i.e. 3·8 per cent. In his valuable works on gall-stones Mayo Robson gives a similar percentage.

Condition of the Gall-Bladder.—From a surgical point of view gall-stones may be divided into two classes:—(1) The solitary, and (2) the numerous. The former are seldom more than two or three in number, and may be of considerable size. They are liable to block the cystic duct, and lead to great distension of the gall-bladder, but not to jaundice, since bile still finds its way along the common duct into the duodenum. The latter are small, and may be present in hundreds. As they allow some bile to trickle by them, jaundice may be absent, and the distension of the gall-bladder is usually intermittent.

The distended gall-bladder may attain enormous proportions, may contain some pints of fluid, and may even so far occupy the abdominal cavity as to be mistaken for an ovarian cyst. The gall-bladder, as it enlarges, tends to follow a line

extending from the tip of the right tenth cartilage across the median line of the abdomen below the umbilicus.

The distended viscus may be pyriform, globular, or cordiform in outline. It may be hard and firm, or soft, or semi-elastic. The tumour, if of no great size, moves with the liver on respiration.

On the other hand, the gall-bladder may be so shrunk as to be scarcely recognisable. It may be completely hidden by adhesions, and these adhesions may be sufficiently wide-extending to entirely confuse the anatomy of the district. A small gall-bladder has been found to be enclosed by adherent omentum and intestine, and is not unfrequently hidden by an enlarged liver. The walls of the bladder may be thin in one case, and very hard and thick in another.

Stones may be discovered to be impacted in either the cystic or the common duct, or in both at the same time.

Some surgeons have advised a preliminary sounding for gall-stones by means of a needle; the practice, however, must be condemned as uncertain, unsatisfactory, and decidedly unsafe. An extensive examination of the region of the gall-bladder by means of a needle is a more dangerous proceeding than an exploratory incision.

Instruments Required.—Scalpels; bistouries; dissecting, artery, and pressure forceps; long-bladed dissecting forceps; large pressure forceps for extensive adhesions, *e.g.* of omentum; rectangular retractors; spatulæ; blunt hooks; scissors; intestinal and other curved needles; needle-holder; sponge-holders; special scoops and forceps for dealing with the calculi (the scoops should be more flexible than the ordinary lithotomy ones); Lister's sinus forceps; long probe; aspirator, or trocar and cannula. A firm pillow or large sand-bag should be at hand.

The Operation.—The general management of the operation, the preparation of the patient, the position of the surgeon and his assistants, conform to the lines already laid down in dealing with abdominal section. Great assistance will be obtained in exposing the gall-bladder region by having a large sand-bag placed behind the patient's loins, so as to lift up and render convex the epigastrium.

The parietal incision is about three inches in length, and can be enlarged as required. It is best made vertically over the most prominent part of the tumour, when one exists, or over the fundus of the gall-bladder when no swelling is evident.

It is easy to enlarge this vertical incision, which is placed in the linea semilunaris or the substance of the rectus muscle, by two nearly transverse shorter cuts at either end; the upper one eneroaches on the rectus muscle, the lower passes outwards, so that the whole becomes a sigmoid incision.

The peritoneum is opened, and the area of the operation is explored with the forefinger. The wound is enlarged as required. Intestine may protrude and hamper the surgeon's movements, or the omentum may be found in the way, or an enlarged liver may overshadow the operation region.

The gall-bladder and the cystic and common ducts should then be palpated (if necessary, the left index finger is passed through the foramen of Winslow), in order to ascertain the exact position of any calculi.

If the gall-bladder be found to be of great size, or very tense from over-distension, it should be carefully aspirated. The site of the needle puncture is protected by sponges, which are wedged in position. As the cyst is emptied, its wall is gradually and gently brought into the parietal wound. This is not always an easy matter, and as the cyst wall is often very thin, it must needs be handled with great gentleness.

Care must be taken that no fluid escapes into the peritoneal cavity. If the bladder be but slightly distended, its wall may be brought to the surface without previous aspiration.

The wall of the gall-bladder is best held and drawn forwards by means of pressure forceps. The amount of traction exercised must be very judiciously regulated. The wall of the gall-bladder is then opened by an incision made between the retaining forceps, all bleeding points are dealt with, and the forceps are readjusted so that the cyst may be drawn well forward, and held in position between the lips of the parietal wound. By means of properly-applied sponges the escape of fluid into the peritoneal cavity is prevented.

The finger introduced through the opening feels for the

stones, notes their position, and ascertains the best means for removing them. Loose stones may be removed with the finger, or by means of scoops or forceps of suitable size and pattern. Long and slender scoops—aided by a finger outside the gall-bladder—are more useful than forceps. If a stone be discovered impacted in the neck of the gall-bladder, it is well, before attempting its removal, to suture the margins of the wound in the gall-bladder to those of the wound in the parietes.

Inasmuch as the walls of the bladder are thin and often

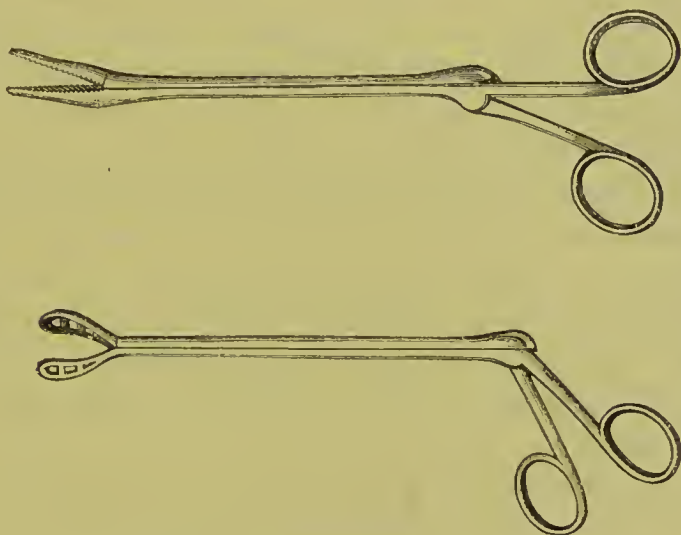


Fig. 413.—TAIT'S CHOLELITHOTOMY FORCEPS.

weak, the greatest care must be exercised in this, the most difficult part of the operation.

It is often well to suture only a part of the gall-bladder wound to the muscular wall, and to introduce the finger into the unsutured interval, so that it may supplement the action of forceps and scoops introduced into the interior of the viscus. Before the suturing is carried out, all the sponges must be removed and counted.

In dislodging stones, Tait's special forceps (Fig. 413) are occasionally of service, and their movements within the bladder may be guided by the finger introduced into the abdomen, and placed against the outer wall of the cyst at the site of the impacted stone.

Sometimes the stone may be prised upwards by means of the finger so introduced.

If the calculus cannot be dislodged, then it may sometimes be very slowly and cautiously chipped into fragments by means of forceps, the action of which is controlled by the finger outside the gall-bladder.

In some cases the impacted stone has been broken up by means of forceps, the blades of which are padded with india-rubber tubing, applied to the stone outside, and therefore through the walls of the neck of the gall-bladder, or by pressure between finger and thumb.

The detritus which results from these procedures is got rid of by repeated washings.

Attempts to push the stone onwards through the duct by means of a probe or director have not met with much success. The proceeding also is not free from risk, and is to be condemned.

In some cases the surgeon has succeeded in dislodging an impacted calculus in the cystic duct by means of frequent syringing through the fistulous opening after the operation had been completed.

It is, however, unsatisfactory to leave an impacted calculus in either of the ducts; it is better to remove it by direct incision. The operator should do his utmost to convince himself that all obstacles in the way of the bile-flow are removed before completing the operation.

The treatment of such stones as are impacted so low down in the duct as not to be reached from the gall-bladder is dealt with in the succeeding section (page 463).

The operation is concluded by completing the suturing of the gall-bladder to the edges of the peritoneum, fascia, and muscular aponeurosis. The gall-bladder is held in position while the sutures are being introduced.

The sand-bag should be removed from the lumbar region before the suturing is performed.

The best suture in a straightforward case is an interrupted suture of catgut, which includes the cyst wall, the parietal peritoneum, and the muscular aponeurosis, but not the skin or

the muscles themselves. Silk sutures are apt to give trouble later on. A drainage-tube is introduced into the gall-bladder, the parts are cleared, and a simple absorbent dressing capable of being frequently and readily changed is applied.

The rest of the wound is closed by sutures of silkworm-gut, two of which for extra safety may include the gall-bladder.

When the gall-bladder is so retracted that it cannot be readily stitched to the parietes, a rubber drain should be fixed in it by a purse-string suture (passing through the wall of the tube) and then packed round with gauze.

Modifications and Complications of the Operation.—

1. *When the stone is impacted in the Cystic Duct, and cannot be reached through the Gall-Bladder.* Small stones so placed have been gradually worked back into the gall-bladder by manipulation.

When this cannot be done, the calculus may be broken up by protected foreeps. If, however, the stone be fixed low down in the cystic or in the common bile-duct the best course to adopt will be incision of the duct (*see* Choledochotomy, page 466), provided that the patient's condition is good enough to warrant the prolonged operation. If not, the cholecystotomy wound is kept open, and through it daily injections of olive-oil or soap solution are carried out in the hope that a solvent action may be exerted on the calculus. The result of such a procedure is uncertain.

2. *When the Gall-Bladder cannot be found on opening the Abdomen.* Dense adhesions to liver, colon, duodenum, and omentum may entirely conceal the gall-bladder, which in some cases has to be "dug out" from the centre of the adhesions. In several cases the most experienced operators have entirely failed to make out the gall-bladder. Under such circumstances a careful search should be made for the common bile-duct, in which a calculus is very probably lodged. Its extraction by incision of the duct is then indicated. A shrunken gall-bladder may present a thick, fleshy wall, and its lumen may be entirely occupied by one or more calculi.

The following case, recorded by Mr. Knowsley Thornton, well illustrates the difficulties of dealing with such a gall-bladder :—

“On opening the abdomen, I found everything so matted together that I at first mistook the head of the pancreas for a thickened gall-bladder. Finding my mistake, I proceeded to carefully make my way through some fresh adhesions between the stomach, the omentum, and the right lobe of the liver, and at last found the gall-bladder, deeply placed and packed with gall-stones. In searching for it I opened a small abscess under the edge of the liver, and let out about an ounce of thick pus, and cleared away some cheesy material. The clearing-out of the stones was long and difficult, and required the aid of various scoops and forceps; when I had finished and washed it out, I found that it was impossible either to remove it, suture it, or suture it into the abdominal opening, and I therefore merely passed a rubber tube to the bottom of the gall-bladder, and brought it out through the abdominal wound.”

3. *When it may be possible to close the Gall-Bladder at once.* In several instances, after the gall-bladder has been opened and the stones have been removed, the wound in the viscus has been at once closed by sutures, the gall-bladder returned within the abdomen, and the parietal wound closed.

This method has been termed “ideal cholecystotomy,” and has been practised by Küster, Czerny, Klingel, Roux, Winkelmann, and others. I have carried it out in a number of cases.

Although the operation, when concluded in the manner described, may be considered to be, from a certain standpoint, an ideal one, it is not a procedure to be indiscriminately recommended. Many fatal cases have been reported. The sutures may give way, and death result from the escape of bile into the peritoneum, as occurred in one of Mr. Thornton's cases (case 8, *loc. cit.*, page 764).

If any small stone which occludes the duct should be overlooked, or if the ducts be not left perfectly clear, the measure may be disastrous.

The general results of the ordinary operation, in which a temporary biliary fistula is established, have been so good that the measure must be very nearly perfect which can compare favourably with it.

The “ideal cholecystotomy” should be carried out in simple

cases in which the walls of the gall-bladder are sound and healthy, have not been much handled, and in which it is perfectly evident that the ducts are quite clear.

It is essential that the contents of the gall-bladder be healthy—*e.g.* contain no pus—and that the closure of the bladder can be carried out with precision. The opening is closed by a continuous suture of fine catgut for the mucous membrane, and a closely placed series of Lembert's sutures for the outer walls.

Comment.—Few operations present wider possibilities or a greater degree of uncertainty than does cholecystotomy. The surgeon who embarks upon this operation will proceed in a speculative spirit. The operation may prove to be quite simple, and to be readily carried out and completed; on the other hand, it may present difficulties of an almost insuperable character, and may even have to be abandoned.

Everything depends upon the anatomical condition of the parts, upon the thickness of the abdominal parietes, the size of the liver, and the presence and extent of adhesions.

In one case (Dr. Parkes's, *Trans. Amer. Surg. Assoc.*, vol. iv., page 299) "the most careful and diligent search failed to find the gall-bladder."

In other instances the gall-bladder has been opened, but no stones have been found.

In some cases the cause of the obstruction in the duct could not be relieved.

It is not uncommon to find that it is impossible to draw the gall-bladder into the aperture of the parietal wound. The course to adopt under these conditions has already been indicated.

In certain of the reported cases more than two hours has been occupied by the operation.

A stricture of the duct has been dilated after the operation by means of instruments introduced through the fistulous tract.

The **after-treatment** calls for little observation. The sutures are removed in due course, and the drainage-tube is dispensed with as soon as the fistulous tract appears to be sound. This will probably be at the end of a week. The sinus

is frequently washed out, and the parts are kept scrupulously clean.

The fistula usually closes without complication in from fourteen to twenty-one days. It has, however, remained patent for months or years.

CHOLEDOCHOTOMY—INCISION INTO THE COMMON BILE-DUCT.

After the first introduction of cholecystotomy in 1879 it was not long before surgeons were led to incise the common bile-duct in order to remove calculi impacted therein. In 1886 Kehr was able to collect from all sources records of eighty-four such operations, with the grave mortality of nearly 40 per cent: Since then the operation has become a frequent one, with an extensive literature and a diminishing mortality (which may now be put at 10 to 15 per cent.). For some years the removal of calculi impacted at the extreme lower (duodenal) end of the duct presented great difficulty; but in 1893 McBurney proved that such calculi could be reached successfully through the duodenum itself. In 1895 Pozzi and Kocher recorded similar cases.

Mr. Mayo Robson has published an admirable paper on the surgery of the common bile-duct, based on seventeen cases of his own, in the *British Medical Journal*, November 5, 1898.

When a stone is detected in the common bile-duct it is sometimes possible to crush it with protected forceps, but the method is uncertain, involves some injury to the wall of the duct, and allows of no exploration of its lumen. Hence some calculi are apt to be left behind. Calculi, impacted for long, cause such dilatation of the duct that after incision the finger can usually be introduced so as to explore the whole length of the duct upwards and downwards. In fact, as already mentioned, the duct has been met with so dilated as to resemble the small intestine. Mayo Robson advocates dilatation with the finger in all cases where it is practicable, "reserving a bent probe or, better still, a slender bent scoop for use where the duct is not capacious enough for the finger. The hepatic duct and its primary branches can be readily explored, and I have removed calculi from them

through an incision in the common duct" (Mayo Robson, *Brit. Med. Journ.*, November 5, 1898). The bent scoop should be made of flexible metal throughout.

The Operation.—The preparation of the patient, the instruments, and the preliminary incision, etc., are the same as for cholecystotomy (page 457). It is essential to have a firm sand-bag behind the patient's loins, and after the abdomen is opened the assistant should draw the liver and costal edge well upwards so as to expose and straighten out the biliary ducts. A vertical incision of the abdominal wall through the semilunar line or right rectus muscle is usually employed, to which it is easy to add a short transverse one. Some surgeons advocate a nearly transverse incision reaching towards the lumbar region. Such a cut is somewhat more liable to be followed by a ventral hernia.

Adhesions of the gall-bladder and liver to the stomach or duodenum, if present, must be carefully separated, and the gall-bladder is drawn upwards with the liver. If the gall-bladder is felt to contain calculi it is opened and the latter are evacuated. After the fluid has been let out the opening should be guarded by sponges or gauze held in place by an assistant whilst the operator traces down the cystic and common bile-ducts. With finger and thumb he ascertains the position and number of calculi present in the common duct. A frequent place for impaction in the duct is just above the orifice into the duodenum, where the duct is somewhat dilated (forming the ampulla of Vater). It will be remembered that the duodenal orifice is the narrowest part of the duct, and that it is situated at the inner and posterior aspect of the duodenum, just at the angle between the second and third parts of the bowel. Besides the ampulla of Vater there may be another dilated portion of the common duct in which calculi are apt to lodge, immediately below the junction of the cystic and hepatic ducts. In tracing down the common bile-duct in its lower half some assistance will be obtained by slightly detaching and depressing the duodenum. The greatest care is necessary in doing this, owing to the close relation of the portal vein (behind the duct) and the hepatic artery to its

left. The pancreatico-duodenal artery (a branch of the hepatic) may give trouble. The lowest inch or more of the duct is quite inaccessible from above, it can only be reached through the duodenum.

In most cases of impacted calculi, however, the stones can be reached through an incision made in the axis of the duct where it lies between the layers of the gastro-hepatic omentum, *i.e.* above the duodenum. The incision is usually made directly over the calculus, the duct being steadied and held forwards with the left hand; the incision should be long enough to admit the index finger. The calculi are then extracted with a scoop, care being taken lest the rush of bile should soil the peritoneal cavity. The index finger is, if possible, introduced through the wound in the duct, and exploration made for any other stone.

The most difficult step of the operation is now to be carried out, that of suturing the small wound in the duct. Fine silk (No. 1) on a curved needle in a needle holder is employed, but the thinness of the duct may possibly prevent the wound from being perfectly closed, and it is essential, therefore, to provide for subsequent leakage. Small metal hammers have been employed for the purpose of introduction into the duct to facilitate suture, but no advantage whatever attends their use. After careful cleansing of the operation area and removal of all sponges, drainage is provided for by a rubber tube, one end of which is placed opposite the sutured duct; the tube is then lightly packed round with gauze, which is brought out of the wound in the abdominal wall at its lowest point. Some surgeons dispense with the tube, using only the gauze drain. The greater part of the abdominal wound is then closed with silkworm-gut sutures.

If a calculus be detected in the ampulla behind the duodenum the following course should be adopted:—The descending portion of the bowel should be incised, and its lumen immediately cleansed with sponges. Whilst the edges of the intestinal wound are held apart by an assistant with the aid of stitch retractors, the operator steadies the calculus with the fingers of the left hand and incises the inner and posterior wall of the

duodenum as close as possible to the opening of the common bile-duct. As some museum specimens show, a large calculus may be found wedged in the actual orifice, and in such a case it may not be necessary to incise the posterior wall of the gut in order to liberate the stone.

Mayo Robson states that sutures need not be placed in the small posterior wound, but the main incision into the duodenum should be accurately closed by a double row of stitches, the first uniting the mucous membrane and the second the outer coats. The abdominal wound is sewn up in the usual manner, and drainage is unnecessary, unless doubt is felt as to perfect closure of the intestinal wound.

After-treatment.—Following these operations on the bile-ducts there is usually considerable pain, and sickness for several hours is a common result. Hence nothing but small quantities of warm water should be given by the mouth for twenty-four hours; a hypodermic injection of morphia and strychnia may be advisable the evening after the operation, with rectal feeding for a couple of days. In any case where jaundice has been present Mayo Robson recommends that chloride of calcium in half-drachm doses should have been given three times a day for two days before the operation, and twice this amount by enemata for the same period after the operation. When the common duct has been incised, the dressings should be changed every day, and dry sterilised gauze applied at each dressing. Although leakage of bile is to be expected for some time, it usually stops after a week or two.

CHOLECYSTECTOMY.

The operation of the removal of the gall-bladder was proposed by Langenbüch in 1882, and has been carried out by him in at least twelve cases. The operation has been adopted by many other surgeons, although the indications originally given by Langenbüch have not of necessity been followed.

So far as collections of published cases at present extend, it would appear that the mortality of the operation is from

5 to 10 per cent. Hans Kehr has performed the operation sixty-four times with three deaths (4 per cent.).

Cholecystectomy is of limited application. It is not proposed that it should take the place of cholecystotomy. It is a more tedious and more serious operation, and should undetected stones still be lodging in the common duct it cuts off one way of escape. It does not, moreover, necessarily remove every nidus for future calculi.

The operation has been carried out when it has been found to be impossible to unite the wound in the gall-bladder to that in the parietes, and in cases in which the walls of the gall-bladder have been too severely damaged by disease or the manipulations of the surgeon to allow suture to be trustworthy or possible. It has also been employed when the cystic duct has been found to be obliterated and the gall-bladder distended, and on account of long persistence of a mucous fistula following cholecystotomy.

The Operation.—The abdominal cavity having been opened, two parallel incisions are made through the peritoneum covering the base of the exposed gall-bladder. The viscus is then bared, and is rapidly enucleated. The separation should begin at the fundus and end at the cystic duct. The two peritoneal flaps are then united by a continuous suture of fine silk, the cystic duct is secured between two ligatures and divided, and the gall-bladder is removed.

The operation may be almost bloodless (as in Mr. Thornton's first case, *Brit. Med. Journ.*, January 5, 1889), or, on the other hand, the hæmorrhage from the liver substance may be free, and may need to be controlled by pressure or by the actual cautery (as in a case by Roux, *Révue Méd. de la Suisse Romande*, October 10, 1890).

It is essential that the site of operation should be drained by a rubber tube or by gauze. In a case recorded by Mr. Southam (*Brit. Med. Journ.*, June 28, 1902) bile-stained fluid continued to escape for six weeks after the operation, apparently from the divided substance of the liver. A rubber drain round which gauze is packed answers well; both should be removed at the end of two or three days.

CHOLECYSTENTEROSTOMY.

By this term is understood the establishment of a fistula between the gall-bladder and the intestine. The not less uncouth, but less precise, term of entero-cholecystotomy has also been applied to this operation.

The procedure has been carried out in cases in which there is an insuperable obstruction in the common bile-duct, such as may have been brought about by destructive inflammatory changes, or be due to the pressure upon the duct of a malignant tumour. Mr. Mayo Robson has carried out the operation with success in the treatment of a biliary fistula, through which, apparently, the whole of the bile was discharged.

The operation of cholecystenterostomy appears to have been first suggested by Nussbaum. The first actual operation was, however, performed by Winiwarter (*Prag. Med. Wochens.* No. 21, 1882).

The Operation.—The operation has been performed in many ways, and no settled practice can be said to be established. If possible, the communication should be made between the gall-bladder and the duodenum; failing this, the opening should be placed on a loop of the jejunum or the colon. It may be done by suturing or with the aid of the smallest size of Murphy's button. Mayo Robson and others have used his bone bobbin as an aid to suturing with great advantage.

The operation has been done in two or even three stages, but undoubtedly it is best to complete it in one.

The proceeding resembles so closely gastro-jejunosomy that no full description is called for. Murphy's button is particularly suited for establishing the anastomosis. The chief difficulty in performing the operation is perhaps the prevention of the escape of bile into the peritoneal cavity. Hence the space around the gall-bladder should be packed with sponges before incising that viscus, and the orifice of the button should be plugged with cotton-wool pledgets until the surgeon is ready to press the two halves together, when of course the plugs should be removed. With good assistance the extravasation of bile can usually be prevented.

The heavier half of the button should be placed in the intestine. The method by suturing alone may be illustrated by one of Mr. Mayo Robson's cases, premising that fine silk is more suitable than catgut as a rule. The account is taken from the *Med.-Chir. Trans.*, vol. lxxiii., p. 64.

In this instance cholecystotomy had been performed for empyema of the gall-bladder. There was a stricture of the common duct, and apparently the whole of the bile was discharged through the fistula. Cholecystenterostomy was performed fifteen months after the first operation. Mr. Robson's account is as follows:—"On March 2nd, 1889, I opened the abdomen in the right linea semilunaris, through the old sear, in the centre of which was the fistula, prolonging the opening two inches beyond the lower end of the cicatrix. The gall-bladder was detached from the parietes, and found to be much contracted and thickened. There was so much matting of the viscera that it was found impracticable to bring up and fix the duodenum or jejunum to the gall-bladder; hence the hepatic flexure of the colon, lying near, was raised and encircled by an elastic ligature, after its contents had been squeezed upwards and downwards. Convenient spots having been selected on the gall-bladder and colon, a circle the size of a florin was marked by a scalpel on each viscus. Along these lines, sutures of fine chromicised catgut were passed, about one-eighth of an inch apart, but they were not tightened until openings, one-third of an inch in diameter, had been made in the centre of the circles, quite through all the coats of the two viscera concerned, and the cut edges of the mucous membrane of the colon had been sutured by a number of interrupted stitches of fine catgut to the edge of the mucous membrane of the gall-bladder. . . . The outer row of ligatures, only involving the serous and muscular coats, was tied and cut off short." The freshened edges of the old fistula were not brought together by sutures; a glass drainage-tube was introduced, and the parietal wound was closed around it.

Bile and faecal matter were discharged from the wound for some time, but it ultimately closed after a period of two months.

CHAPTER XVI.

SPLENECTOMY.

SPLENECTOMY, or extirpation of the spleen, has been carried out in cases of injury or prolapse of the spleen, in certain instances of movable spleen, in simple hypertrophy of the organ, and in some cases of tumour of the spleen. Experience has shown that the extirpation of the leucocythæmic spleen is an unjustifiable operation.

The history of the operation is thus given by Sir Spencer Wells in his "Surgical Treatment of Abdominal Tumours," page 182 :— "I think we may look upon the case of extirpation of the spleen attributed to Zaccarelli in 1549 as apocryphal. We do not find anything authentic till 1826, in which year Quittenbaum, of Rostock, removed a diseased spleen from a woman, who died of shock in six hours. Then, in 1855, Kückler, of Darmstadt, reported that he had done the operation on a man who had enlarged spleen from ague. He encountered no special difficulty in his undertaking, but lost the patient from hæmorrhage two hours after operation." The first operation in England was performed by Sir Spencer Wells in 1865. The patient lived six days. Péan, who operated in 1867, had what may be termed the first successful result in modern times. Since then the operation has been extensively practised, and with a considerable degree of success.

Anatomical Points.—The spleen most closely approaches the surface in the parts covered by the tenth and eleventh ribs. Above this it is entirely overlapped by the edge of the lung. It is in all parts—when of normal size—separated from the parietes by the diaphragm.

Its long axis coincides very nearly with the line of the tenth rib. "Its highest and lowest points are on a level, respectively, with the ninth dorsal and first lumbar spines ; its

inner end is distant about one and a half inches from the median plane of the body, and its outer end about reaches the mid-axillary line" (Quain).

The three surfaces of the spleen—gastric, renal, and phrenic—are well shown in Fig. 414.

The peritoneum which invests the spleen is reflected at the hilum, and, passing on to the stomach, forms the gastro-splenic omentum. This omentum contains the splenic and other

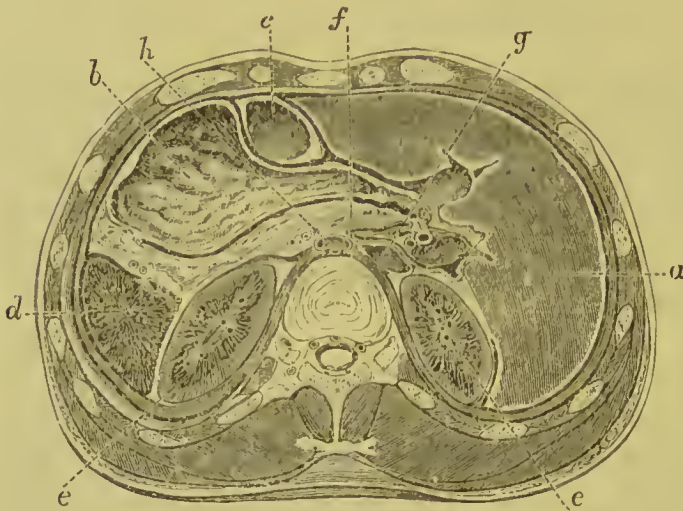


Fig. 414.—HORIZONTAL SECTION THROUGH THE UPPER PART OF THE ABDOMEN. (*Rüdinger.*)

a, Liver; *b*, Stomach; *c*, Transverse colon; *d*, Spleen; *e*, Kidneys; *f*, Pancreas; *g*, Inferior vena cava; *h*, Aorta with thoracic duct behind it.

vessels, and forms the pedicle, which has to be dealt with when the organ is excised. The splenic artery breaks up into branches—which vary from five to seven in number—just before it reaches the gland.

These branches vary in length and size, and will probably have to be dealt with individually in cases of great enlargement.

The vasa brevia, from four to six in number, are directed forwards and to the right, and lie also in the gastro-splenic omentum. Some issue from the trunk of the splenic artery, some from its terminal branches. They all reach the left extremity of the stomach. Some or all of these branches may be divided in the pedicle.

The gastro-epiploica sinistra artery also occupies the gastro-splenic omentum for a small part of its course.

The splenic vein is placed below the artery. Its tributaries correspond to the branches of the artery, and the trunk of the vessel is of considerable size.

The comparative thinness of the spleen capsule, and the peculiar friability of the splenic tissue, must be borne in mind.

Instruments Required.—Those required for ovariectomy, with the exception of such special instruments as the ovarian trocar.

The Operation.—The parietal incision is conveniently made along the outer edge of the left rectus muscle. It is vertical, and may need to be of considerable length. Its upper extremity should lie near to the ribs. In many of the reported cases a median incision has been made use of, and in dealing with very large tumours it is the more convenient.

The peritoneum having been opened, the tumour is examined. If any adhesions exist, they must be at once dealt with. If very extensive adhesions are discovered, which serve to connect the spleen with adjacent viscera and to obscure the anatomical details of the part, the operation had probably better be abandoned. The omentum is not unfrequently found to be adherent to the tumour, and some trouble has arisen from the accidental division of the large vessels which may be found in that structure.

The enlarged spleen is now gently drawn through the wound. The organ must be handled with the greatest care, and any attempts to force it through a comparatively small incision must be avoided. The spleen has been ruptured during removal as the result of too severe pressure brought to bear upon it.

The tumour must be allowed to escape slowly, and as it protrudes the pedicle must be from time to time inspected, lest undue traction be made upon the vessels therein, and especially upon the thin-walled veins.

Dragging upon the pedicle has produced alarming symptoms of collapse, due, no doubt, to injury to the splenic nerve plexus, which is derived from the solar plexus.

The most important feature of the whole operation is concerned with the treatment of the pedicle.

In general terms, the practice advised by Sir Spencer Wells may be followed. He recommends “temporarily securing all the blood-vessels by pressure forceps as near to the spleen as possible, then removing the enlarged organ, afterwards applying

silk ligatures by transfixion behind the forceps, and tightening them as the forceps are removed. All the ends of the silk should be cut off near the knots." He condemns the practice of Langenbeck, who advises that the splenic artery be tied as close to the cœliac axis as possible, and before it divides into its many branches. He points out that this could not be often done without much disturbance of the pancreas, and that a ligature applied close to so large a trunk as the cœliac axis is likely to be followed by secondary hæmorrhage (*Med.-Chir. Trans.*, vol. lxxi., page 262).

In more than one case a small artery has slipped out from its ligature, and severe bleeding, difficult to check, has followed.

Some surgeons tie the pedicle in two intertwined ligatures and then add a separate ligature around the whole stump.

No especial advantage has been shown to attend the practice of ligaturing the artery and the vein separately.

Care must be taken that the structures of the pedicle are relaxed at the moment that each ligature is tied. It is better to err in the direction of applying too many ligatures than to attempt to include the whole pedicle in one or even two knots. The ideal method—if time ever permitted—would be to tie each vessel separately.

In dealing with the pedicle, the pancreas has been wounded, and the tip or tail of that organ has even been included in the ligature.

The ligatures having been all cut short, the peritoneal cavity is well cleansed, and the abdominal wound is closed.

The movable or wandering spleen can very seldom indeed require to be removed. It gives trouble not by mere wandering, but by becoming twisted on its pedicle. The rotation of the pedicle may be such that all blood supply from the splenic artery is cut off, and the organ receives its nourishment through adhesions mainly of the omentum. I have in two instances exposed a movable spleen which had become twisted on its pedicle. In one case the organ was in the pelvis, was easily felt *per rectum*, and was supposed to be a congenital sacro-cocegeal tumour. In the other instance it was in the left iliac region, and had been diagnosed as an ovarian cyst.

In both cases perfect relief of all symptoms followed the operation, which was represented by untwisting the pedicle as far as was possible, by dividing adhesions likely to cause trouble, by separating intestine which might have become compressed or kinked, and by so securing the pedicle by numerous sutures that further rotation could not occur. In the latter of the two cases the spleen was the seat of an enormous infarct.

Comment.—The great risk of the operation is hæmorrhage from the pedicle. In twenty-nine cases collected by Collier, no less than fourteen died directly from bleeding.

The treatment of the pedicle constitutes the main feature of the operation, and next to it must rank the treatment of such adhesions as may exist.

Results.—Mr. Wright, of Manchester, has collected sixty-two cases of splenectomy. In twenty-two cases the operation was for leukæmia, and all the patients died. In twenty-three cases the spleen was the seat of simple hypertrophy, and fifteen patients died. Of seven who were operated on for malarial disease, five recovered; and of three on whom splenectomy was performed for cystic disease, all recovered (*Med. Chron.*, December, 1888).

The operation in cases of wounded or prolapsed spleen has been very successful. Ashhurst has collected twenty-one cases of splenectomy performed for traumatism, and in all recovery followed.

CHAPTER XVII.

OPERATIONS ON THE KIDNEY.

Anatomical Points.—The kidneys are deeply placed, and are most accessible to pressure at the outer edge of the erector spinæ just below the last rib. They rest about equally upon the diaphragm and the anterior layer of the transversalis aponeurosis, which latter structure separates them from the quadratus lumborum. They rest to a slight extent also upon the psoas.

The upper edge of the kidney corresponds with the space between the eleventh and the twelfth ribs, and with the eleventh or twelfth dorsal spine. The right kidney is a little lower than the left. The lower end of the kidney is about on a level with the middle of the third lumbar spine (Fig. 415). The hilum is about opposite to the gap between the first and second lumbar spines.

The inner border of the gland at its upper part is about one inch from the middle line; the outer border at its lower part is $3\frac{3}{4}$ inches from that line.

A horizontal line passing through the umbilicus will probably correspond to the lower end of the right kidney, but will be entirely below the left.

It must be noted that these levels vary considerably, and are to be taken only as representing the average. Moreover, the kidneys move to some extent with respiration.

A vertical line carried upwards from the middle of Poupart's ligament has one-third of the kidney to its outer side, and two-thirds to its inner side.

The area corresponding to the kidney on the posterior surface of the body is indicated in Fig. 415.

In relation with the anterior surface of the right kidney are the under-surface of the liver, the second part of the duo-

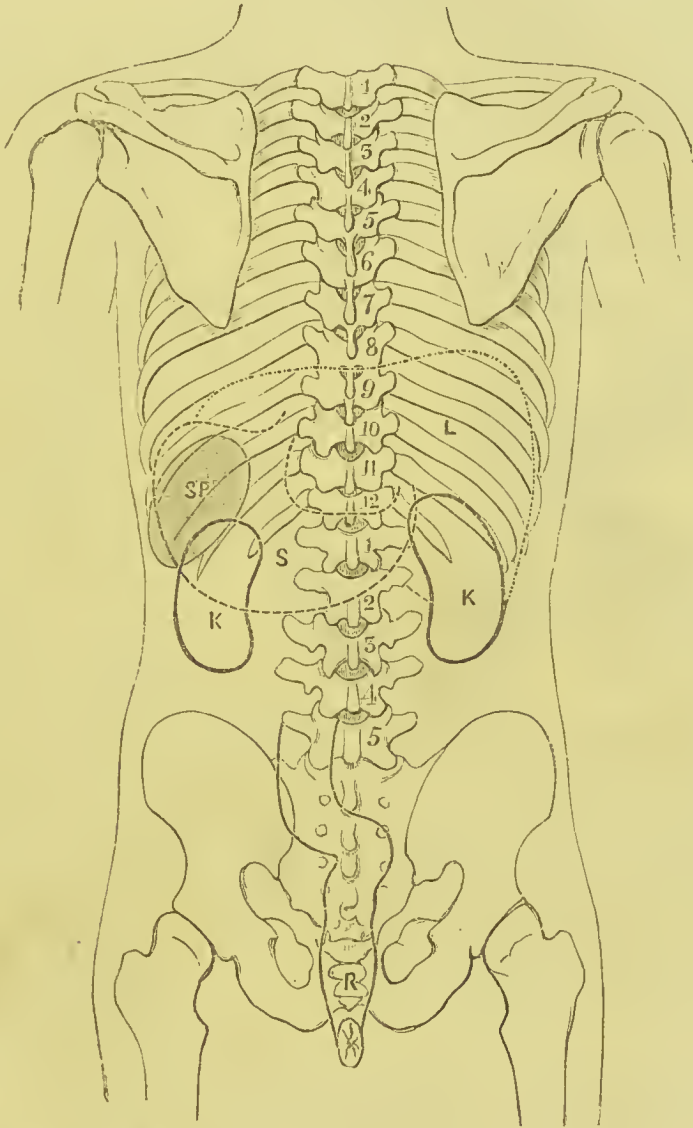


Fig. 415.—DIAGRAM TO SHOW THE RELATIONS OF THE VISCERA TO THE PARIETES.
(Posterior view.)

s, Stomach ; L, Liver ; K, Kidney ; SP, Spleen ; R, Rectum.

denum, the commencement of the transverse colon, and the ascending colon.

In the same relation on the left side are the fundus of the stomach, the pancreas, and the descending colon.

Crossing the posterior surface of the kidney obliquely

from above downwards and outwards, are branches of the last dorsal nerve, and of the first lumbar artery, together with the ilio-hypogastric and ilio-inguinal nerves.

The fatty tissue in which the kidney is embedded is of much surgical importance. It is more abundant behind than in front, and the laxity of its substance permits of the ready

enucleation of the organ. In certain diseased conditions this fatty area may be occupied by inflammatory tissue, which is found to be intimately and inconveniently adherent to the kidney.

The structures which enter the hilum of the kidney form also the surgical pedicle of the kidney. They consist of the renal vessels, the pelvis of the ureter, lymphatics, nerves, and connective tissue.

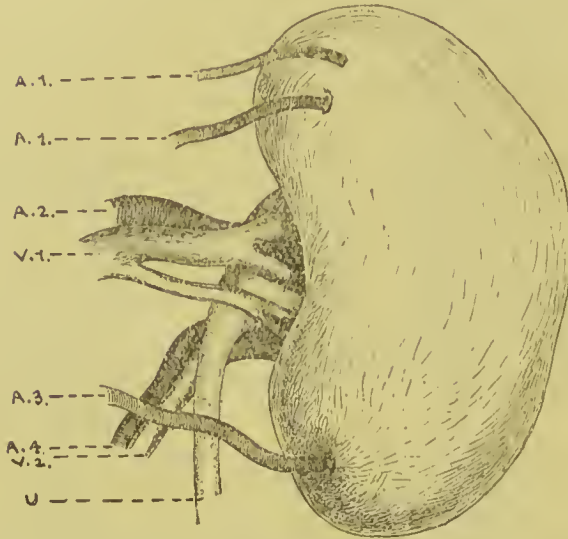


Fig. 416.—ABNORMAL ARRANGEMENT OF THE RENAL VESSELS. (*From a dissection in the London Hospital Museum.*)

A.1, Two smaller arteries entering the summit of the kidney; A.2, Chief renal artery entering the hilum in front of the ureter and in front of V.1, the chief renal vein; A.3, Arterial branch from the aorta crossing in front of the ureter to the lower end of the kidney; A.4 and V.2, Artery and vein running upwards to the hilum behind the pelvis of the ureter; U, Ureter.

(The kidney is viewed from behind.)

The renal artery is the size of the branchial, and divides just before reaching the hilum into four or five branches. These branches lie as a rule behind the corresponding branches of the vein and in front of the pelvis of the ureter. They give small branches to the capsule and the ureter.

The renal artery may be replaced by two, three, four, or even five branches. These usually arise from the aorta, but may take origin from the lumbar, iliac, or inferior mesenteric arteries (see Fig. 416).

The branches of the renal artery may enter the upper end

or the anterior surface of the kidney instead of the hilum, and may give off supernumerary branches to adjacent parts.

These abnormalities of the renal vessels may prove of importance in operations upon the kidney, especially nephrectomy. Thus, for example, a large accessory renal artery entering the summit of the kidney may be difficult to secure, or an artery passing behind the pelvis of the ureter may give trouble in nephro-lithotomy. A branch which curves round the lower border of the pelvis to reach the posterior surface of the kidney is so frequently met with that it is given as normal by Testut.

There are constantly present a number of fine arterial twigs supplying the capsule and even part of the cortex of the kidney, which are not derived from the true renal arteries, but come from the lumbar or suprarenal vessels. In the cases of congenital displacement of the kidney mentioned below, the main renal arteries may be derived from the common or internal iliac vessels or even in part from the middle sacral (which is a rudimentary prolongation of the abdominal aorta).

With regard to the veins of the kidney, it should be noted that there is a fine network all around the organ which communicates with the lumbar veins, the suprarenal, the spermatic or ovarian, the phrenic, and those accompanying the adjacent last dorsal and lumbar nerves. Hence there is usually considerable venous oozing when the kidney is detached from its fatty capsule.

The main renal veins, formed by the junction of several branches (usually placed in front of the corresponding arteries) at the hilum, run almost transversely inwards, and enter the vena cava at about the same level. There is, however, an important difference between the length of the right renal vein and that of the left. The right kidney normally touches the vena cava at its upper end, and the right renal vein is rarely more than one inch long (frequently less); whilst the left renal vein, which crosses the aorta, is usually from two to three inches long. In performing nephrectomy on the right side many accidents have happened owing to the shortness of the renal vein—the vena cava having been wounded or ligatured in several cases (there is an example of the latter in St. Bartholomew's

Hospital Museum). The close relation of the right kidney to the vena cava and the resulting shortness of the renal vein on this side must be always remembered.

The ureter loses its cylindrical form on a level with the lower end of the kidney, where it begins to expand into the funnel-shaped cavity called the pelvis (Fig. 417). After entering the hilum the pelvis divides into two, or even three, primary

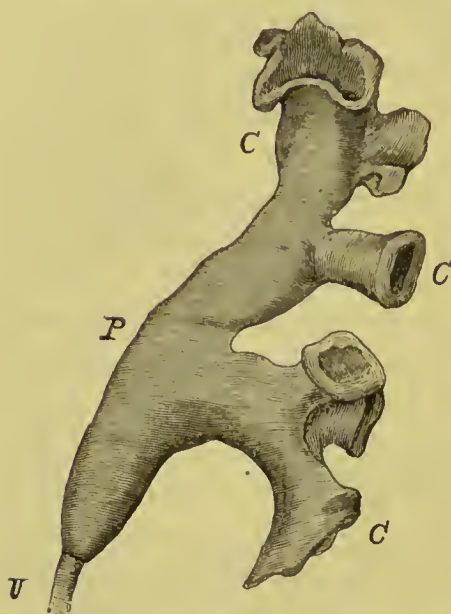


Fig. 417.—CAST OF THE INTERIOR OF THE UPPER END OF THE URETER. (*Henle*).
U, Ureter; P, Pelvis; C, Calyces.

tubular branches, which in turn end in several truncated short and wide pouches, the calyces. In the pelvis of the ureter, or in the calyces, calculi are frequently lodged (Fig. 417). The calyces are normally too narrow to admit of the introduction of the finger for exploration, but are frequently dilated by disease.

The abnormalities of the kidney are of considerable surgical importance. They are very fully dealt with in Mr. Henry Morris's work on "Surgical Diseases of the Kidney and Ureter."

One, or less frequently both, kidneys may be congenitally misplaced. The left is more often out of place than the right, and the organ may be found over the sacro-iliac synchondrosis, or the promontory of the sacrum, or be discovered in the iliac fossa or pelvis. The misplaced kidney is often mis-shapen, and may exhibit a more or less extreme degree of lobulation. The ureter may be double.

The two kidneys may be fused. "The lowest degree of fusion is seen in the horseshoe kidney. The two kidneys are united at their inferior portions by a flat, riband-like, or rounded bridge of tissue, which crosses the vertebral column. In the higher degrees the two lateral portions approach one another more and more, until they reach the highest degree, in which

a single disc-like kidney, lying in the median line, and provided with a double or a single calyx, represents complete fusion" (Rokitansky).

When the two kidneys are united by a web of connective tissue, the condition is no bar to operation.

There may be an entire absence of one kidney. The single kidney may be lateral or median in position.

Mr. Henry Morris estimates that congenital absence or extreme atrophy of one kidney may be expected to be present in 1 in about 4,000 cases.

The horseshoe kidney may be looked for in the proportion of 1 to every 1,600 cases, and the single fused kidney in 1 in about 8,000 cases. Examples of wasted, small, and shrunken kidneys are certainly much more common than this amongst those patients who are the subjects of renal operations.

History of Operations upon the Kidney.—It would appear that during the earlier days of surgery incisions had been made from time to time into fluctuating swellings in the loin, and through such wounds abscesses and cysts were evacuated which were subsequently shown to have had origin in the kidney.

In like manner ancient records contain accounts of cases in which renal calculi were removed through the loin, their discharge having followed the evacuation of an abscess in that region. These early operations were all more or less casual.

The possibility of removing stones from the kidney is discussed by more than one ancient writer, and such a measure of treatment was now and then advised in the vague, hap-hazard, and irresponsible language that marks many of the earlier surgical records.

A case is recorded in the *Philosophical Transactions* for 1696 by Dr. Bernard which would seem to have been one of nephro-lithotomy. Some discredit has been cast upon the case, and the details of it are not sufficiently complete to make it of scientific value. The case certainly had no influence upon surgical practice.

The first operation of nephro-lithotomy was performed by Mr. Henry Morris in 1880. The operation was deliberately undertaken and carefully planned, and it forms the basis and starting-point of the modern procedure.

Nephrectomy had been performed unintentionally several times before it was deliberately carried out as a precise operation by Gustav Simon, of Heidelberg, in April, 1869. The operation was performed for an intractable fistula of the ureter, and the patient made an excellent recovery. In Mr. Barker's article in the *Med.*-

Chir. Trans., vol. lxiii., will be found an account of the first twenty-eight reported cases of nephrectomy.

Nephroraphy was first performed by Dr. Hahn, of Berlin, in April, 1881.

Since the various operations were introduced, the development and application of each measure have been very rapidly extended. A complete account of the subject will be found in Mr. Henry Morris's work on "Surgical Diseases of the Kidney and Ureter" (two volumes, 1901).

Operations Performed.—The following operations will be described :—

1. Nephro-lithotomy, or incision of the kidney or its pelvis for stone.
2. Nephrotomy, or incision of the kidney, including puncture of the kidney.
3. Nephrectomy, or removal of the kidney.
4. Nephroraphy, or fixation of a movable kidney.
5. Uretero-lithotomy.
6. Plastic operations on the pelvis and ureter.

I. NEPHRO-LITHOTOMY.

The operation of incising the kidney for the purpose of removing renal calculi has been carried out with remarkable success in a large series of cases.

Discrimination must be exercised in selecting subjects for operation, and the diagnosis should be as clear as possible. The symptoms of renal calculus may be simulated by several other conditions, and a long list of cases might be collected in which an exploratory operation has failed to reveal the calculus, in some of which it was really present. The value of the Röntgen rays as an aid to diagnosis is considerable. Unless the patient be very stout, this method will very usually indicate the presence of a stone, its size and position, and whether there is more than one.

The exposure to the rays need not be a long one in order to obtain satisfactory results; indeed, one of ten to fifteen seconds will often give a better radiograph than a much more prolonged one, as the blurring of shadow due to respiratory movement can be easily avoided with the short exposure.

A well-marked shadow of a renal calculus will enable the operator to mark its exact position, measuring from the iliac crest and spines.

The X-ray photographs are, however, not an infallible test for renal calculi. Very small stones cannot be detected by them, nor larger ones in stout patients; and an abscess in the kidney may occasionally simulate calculus by causing a defined shadow. Tumours in or about the kidney may cause a faint shadow hardly to be compared with that caused by a stone. Even in thin patients, delusive indications have been given, and in any case two or more skiagrams should be prepared by different operators.

Tuberculous disease is most apt to be mistaken for renal calculus, and, indeed, the two conditions sometimes co-exist.

It will be convenient to take this operation of nephrolithotomy as the type of the series of renal operations about to be described.

Instruments Required.—Scalpels; bistouries; dissecting, artery, and pressure forceps; toothed forceps; two rectangular metal retractors. The following special instruments are used in dealing with the stone:—A stout slender needle in a handle, or a hare-lip pin for sounding the calculus; long-bladed tenotome; suitable probes and scoops; steel director; the smallest-sized bladder-sound (*see* page 491); Lister's sinus forceps; dressing forceps; gall-stone forceps. A small periosteal elevator may be useful in detaching some stones, and a No. 3 Duncan's uterine dilator has been recommended as a convenient sound.

Preparation of the Patient.—The preparation of the patient should be upon the lines already laid down in dealing with Abdominal Section (page 225).

It is desirable that the bowels, and especially the colon, should be as well emptied as possible.

The skin over the site of the intended incision should be carefully prepared with full aseptic precautions.

Two methods of operating will be described, viz. the lumbar method, and the abdomino-lumbar method.

A.—THE LUMBAR OPERATION.

(1) **Exposure of the Kidney.**—The patient lies upon the sound side, as near to the edge of the table as possible. The loin of the affected side is well exposed, and to widen the interval between the last rib and the crest of the ilium a narrow hard cushion or sand-bag may be placed under the loin of the

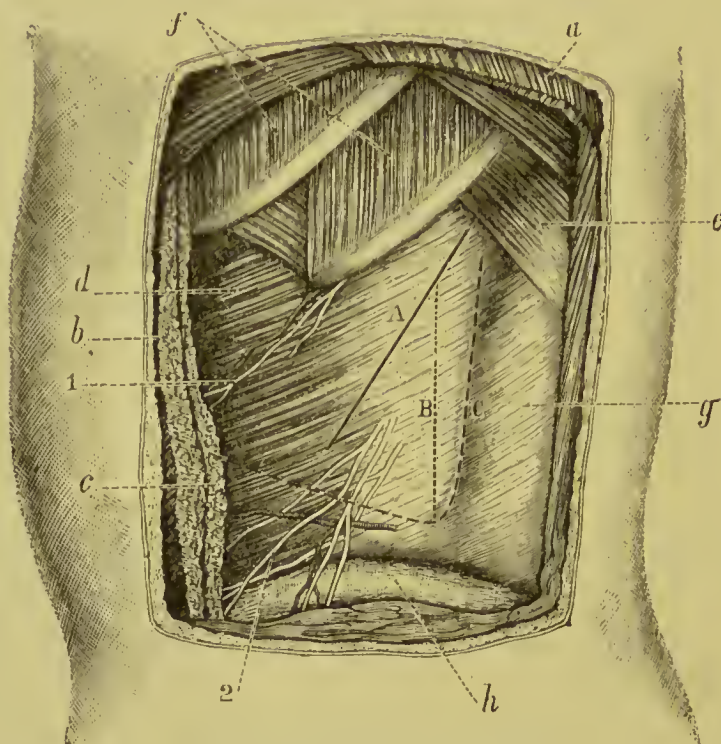


Fig. 418.—OPERATIONS ON THE KIDNEY.

A, Incision for exploration, for nephrotomy and nephro-lithotomy; B, Additional incision for nephrectomy; C, König's lumbo-abdominal incision for nephrectomy. *a*, Latissimus dorsi; *b*, External oblique; *c*, Internal oblique; *d*, Transversalis; *e*, Serratus posticus inferior; *f*, Intercostals; *g*, Fascia lumborum over erector spinæ; *h*, Crest of ilium; 1, Intercostal nerve and artery; 2, Twelfth dorsal nerve and lumbar artery.

sound side. This pillow may be a little in the way in the later stages of the operation, in which case it may be removed.

The surgeon stands by the patient's back, leaning over the trunk. An assistant stands on each side of him, to sponge and assist in retracting the wound. A third assistant is placed on the other side of the table, opposite to and facing the surgeon. His chief duty is to press the kidney towards the loin when the organ has been exposed.

The twelfth rib should be definitely recognised and well defined. It is occasionally absent or rudimentary, and then the pleural sac descends below the eleventh rib, which (unless the precaution is taken of counting the ribs from above) may be mistaken for the twelfth. (*See* page 493).

An oblique incision is made across the costo-iliac space. The cut commences above, about half an inch below the last rib and close to the outer border of the erector spinæ. It is continued downwards and forwards towards the crest of the ilium (Fig. 418, A). Its length must depend upon the space available, and upon the depth of the tissues of the loin. It will suffice if it be at first three inches in length, and it may be subsequently enlarged to four or five inches as required.

Other forms of incision are alluded to in the Comment upon the operation (page 493).

After dividing the skin, superficial fascia, and fat, the outer border of the latissimus dorsi and the hinder border of the external oblique muscles are exposed. The fibres of both are vertical, and they are divided to the full length of the skin incision. The sheath of the erector spinæ muscle should not be opened. The internal oblique muscle and the posterior aponeurosis of the transversalis muscle (fascia lumborum) are now laid bare. The fibres of the former muscle run upwards and inwards. Piercing the fascia near the rib there may possibly be seen branches of the last dorsal nerve and last intercostal artery, and, nearer the iliac crest, the first lumbar nerve and a branch of the last lumbar artery. Both muscle and aponeurosis are divided to the full length of the wound. No director should be employed, and any bleeding points which give trouble may be ligatured, as pressure forceps are apt to be in the way. It is, however, very rarely that there is any need for a ligature at this stage. The anterior or outer edge of the quadratus lumborum, and the anterior layer of the fascia lumborum, are exposed. The latter is freely divided. The muscle may be severed if part of it encroaches upon the field of the operation.

As each layer of tissue is divided, the severed parts are retracted by means of broad, rectangular metal retractors.

The *fascia transversalis* is now reached and divided, when the perirenal fatty tissue is exposed.

The retractors are made to take up the whole of the severed structures down to the exposed fatty capsule, and the depths of the wound are laid open to the utmost.

The perirenal adipose tissue is now opened up with the forceps and finger, and the kidney is reached and laid bare. In order to bring it well into the field of the operation, an assistant should press the anterior wall of the abdomen with the palms of both hands towards the exposed loin, and endeavour, as it were, to force the kidney into the incision.

Through the free opening made in the perirenal fat the finger is introduced and the whole kidney systematically examined.

As the surgeon approaches the back of the kidney, there will be sometimes noticed, writes Mr. Morris, a difference in the character of the fat, that immediately in contact with the kidney being finer in texture and of a delicate primrose colour.

If long-standing inflammation has been present, the surrounding tissues will be confused, will be matted together, and will offer a more or less firm resistance to the exploring finger.

(2) **Detection and Removal of the Stone.**—The use of the skiagraph has simplified both these procedures. It is possible that the exact position, size, and roughly the number of calculi present in the kidney (for they are often multiple), can be thus determined beforehand. With its employment in skilled hands there is now less need to pierce the kidney in various directions with an exploring needle, or to disturb it from its connections and to bring it out into the wound. The operation is shortened, and the degree of renal injury materially decreased. It may possibly be said that the surgeon is rarely justified in exploring a kidney for stone unless the X-rays have given positive indication of its presence. It must, however, be again observed that a stone has been apparently indicated by a shadow in the skiagraph, and has been proved on exploration not to exist. On the other hand, stones of considerable size have not been indicated by skiagraphs taken by competent operators. Increased precision in the skiagraphy of the kidney is certainly

to be expected. In the great majority of cases the calculi are found at the orifice of the ureter, in the pelvis (especially its lower segment), or in one of the calyces. The incision should be made through the posterior wall of the pelvis (Fig. 419).

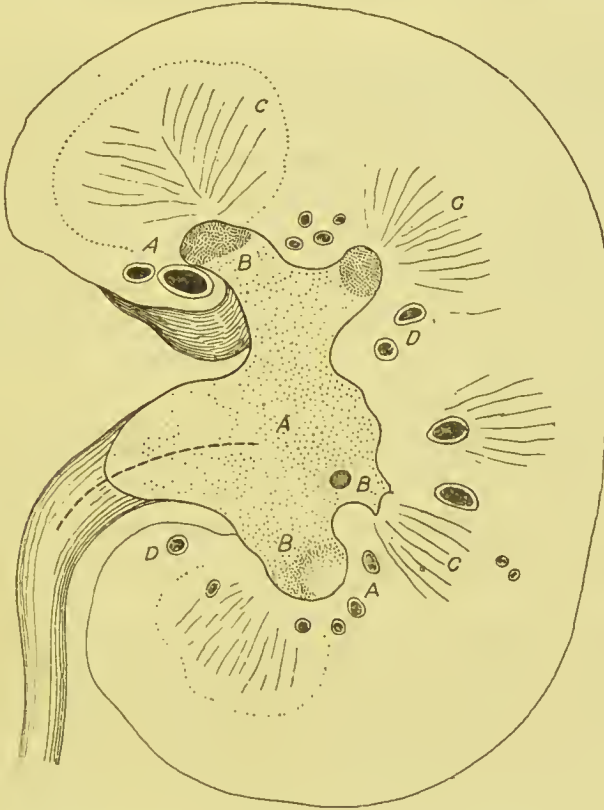


Fig. 419.—VERTICAL SECTION THROUGH THE LONG AXIS OF KIDNEY. (*From a specimen in the London Hospital Museum.*)

The dotted line passing through the upper end of the ureter and into the pelvis indicates the best incision for reaching calculi in the latter or in one of the calyces (B). A section through the convexity of the cortex is seen to divide a number of arteries and veins of considerable size. A, D, Columns of Bertin and large vessels cut across; c, Pyramids of Malpighi.

The incision should always be long enough to admit the finger, and should be placed directly over the stone. It is frequently advisable to encroach on the renal tissue, in which case the wound should radiate from the hilum parallel with the main vessels. It should not be forgotten that a branch of renal artery or vein is often present behind the pelvis, and care should be taken to avoid this if possible. The plan of entering the pelvis through a wound made through the outer border of

the kidney is not to be commended. As shown in Fig. 419, such an incision must pass through a considerable thickness of the gland, and will probably divide several important vessels; in fact, the hæmorrhage following "bisection of the kidney" has in some cases necessitated nephrectomy, and even led to the patient's death.

The idea on which section through the cortex is based is that such wounds heal more readily than those made through the pelvis; but the latter, whether sutured or not, soon close up. As a general rule, the incision should run in the dotted line A in Fig. 419, or a continuation of it. Such an opening is well adapted for exploring the whole of the pelvis with finger or sound. Of course, if the skiagraph has revealed a small calculus near the cortex and far from the pelvis, the surgeon should cut down directly over it.

It may happen that the aid of the skiagraph is not to be obtained; the symptoms point strongly to renal calculus, but the surgeon is in ignorance as to its position. Under these circumstances the following remarks would apply.

The posterior surface of the kidney is first examined with the finger, whilst the organ is well supported in front by the hand of the surgeon or his assistant. The finger-tip is then passed over the anterior surface of the gland while the kidney is supported by the psoas muscle and the spinal column. "To do this satisfactorily, it is best to turn the patient on his back, so that the kidney may fall into its natural place. The examining finger is thus left free to test the degree of resistance of the renal structure without having to use any force in keeping the kidney against its counter-resistance, viz. the vertebræ and muscle" (Morris).

If no indication of the stone be afforded upon either of these surfaces, the whole organ is tilted forward, and the pelvis is examined from behind. Each part of the kidney is squeezed and rubbed between the fingers, and any unduly hard or unduly soft spot noted.

A small stone may be readily overlooked, and, indeed, the presence of such a calculus may not be apparent to the finger even when the kidney has been removed and is examined upon a table.

If any hard or raised area be made out, the exploring-needle may be at once thrust into it to establish the presence of the stone.

Should no result follow the examination so far, the exploring-needle may be used. It is driven systematically into the substances of the kidney from many points. Twelve or more of such

exploratory punctures may be made. While the needle is being used, the kidney must be fixed firmly in the wound. The instrument, which should not be more than two and a half inches in length, is best introduced from one end to the other of the posterior border, and each thrust should be towards the hilum. The length of the needle will scarcely allow of the renal vessels being reached.

It should, however, be noted that the use of this sharp needle is both an uncertain and a somewhat dangerous method.

As a next step, the plan advised by Mr. Jordan Lloyd may be adopted. "The procedure is analogous to the method of detecting stone in the bladder, differing from it only in one particular, that we reach the kidney's interior through an opening artificially made. When the kidney is exposed through a lumbar wound, I puncture its lower end with a long-bladed tenotome in a direction upwards and inwards, making for the lowest of the calyces. If the surgeon is observant and his knife is keen, he will readily appreciate the moment when a cavity is struck by the altered resistance offered to the puncturing instrument. . . . Into this opening I pass a child's bladder-sound, and systematically explore the whole interior of the pelvis. This sound should be of special construction, having a beak not more than one-third of an inch in length, a stem about seven inches, and the size of a No. 3 English catheter. It should be passed at once to the top of the kidney cavity, a distance of nearly four inches, and the exploration should be carried out systematically from above downwards, the point being rotated in all directions so as to investigate both tubes and calyces as the instrument is withdrawn."

Supposing that still no stone is discovered, an incision may be made into the posterior border of the kidney, sufficiently deep to reach the calyces. These cavities may then be explored by the finger, aided by a sound or probe.

The great advantage of determining the position of the stone or stones by skiagraphy may once again be urged. With its aid the surgeon no longer works in the dark; he can seldom fail to find the calculus, nor, having removed one, is he likely to leave others behind.

With regard to their *removal*, a pair of small lithotomy forceps, or a scoop aided by the surgeon's finger, will answer the best. "With a scooping movement of the finger, introduced through the incision, the stone, unless a branched or very large one, can be raised to the surface of the parietal wound on the point of the finger or a pair of forceps introduced into

the kidney by the side of the finger, and the stone seized and withdrawn" (Morris).

The object of the surgeon should be to remove, if possible, the calculus without breaking it, and with the infliction of the minimum of injury to the pelvis or renal substance. If, however, the stone be large and irregularly branched, it may be found necessary to break it up into two or more fragments, and to remove them separately, so as to avoid undue laceration of the kidney. Such removal should be followed by a free irrigation of the part with warm sterilised water. In this way Mr. Kendal Franks removed a stone weighing, when complete, 171 grains (*Lancet*, vol. ii., 1880, page 1223).

Some of the largest stones met with have been removed entire. The great calculus, weighing no less than 473 grains, removed by Mr. Jacobson in 1886, was extracted entire (*Clin. Soc. Trans.*, 1889, page 203).

The number of stones removed may be considerable. In one of Mr. Jacobson's cases no less than forty-six calculi, most of them of large or fair size, were removed from the kidney of a boy aged fifteen.

When the calculus is found to block up the orifice of the ureter, its removal is often a matter of the greatest difficulty, involving infinite patience and no little manipulative skill. The reader may be referred to the section on Uretero-lithotomy (page 517) for a discussion of this subject.

The bleeding which follows upon the removal of the stone will usually yield to the well-applied pressure of a fine Turkey sponge. If, however, the oozing cannot be checked by this means, the wound in the kidney may be plugged with strips of iodoform or simple gauze, which can be removed in twenty-four hours.

If the case and the operation be uncomplicated, the wound made in the pelvis of the kidney should be closed by a series of very fine silk sutures. I have adopted this procedure almost without exception and with excellent results. In instances in which I have opened the pelvis of the kidney and have also incised the body of the gland, I have closed both wounds with sutures, and have had no reason to regret the steps. I am of

opinion that the closure of the renal wound by sutures should be the rule in this operation. Should there be any suppuration, or should much damage be done to the renal wound in reaching and extracting the stone, or should primary union be considered for any reason improbable, the renal wound should be left open, and a drainage-tube and gauze drain be passed to the bottom of the incision.

(4) **Closure of the Wound.**—If the incision in the kidney be sutured, then the parietal wound may be entirely closed by silkworm-gut sutures passed deeply. If the renal wound be not sutured, then a full-sized drainage-tube should be introduced to the very bottom of the incision. It should be in contact with the wound in the kidney; around it should be packed some gauze, which will act as an additional drain.

The wound in the parietes is then closed in the usual way, and the drainage-tube secured in place by a suture. Silkworm gut forms the best suture material.

The wound may be dressed with dry wool dusted with iodoform, or with pads of sterilised gauze and wool.

The dressing in any case is best secured by means of a binder or many-tailed bandage.

Complications and Modifications of the Operation.—

a. Exposure of the Kidney.—It is important that the incision made in the parietes should be sufficient to meet the needs of the particular case. When the patient is stout and the loin deep, a considerable incision may be called for.

Additional room may be gained by converting the usual lumbar incision into a T-shaped one by cutting downwards towards the crest of the ilium (*see Nephrectomy*, page 502); or the quadratus lumborum muscle, when exposed, may be freely incised in a line at right angles to its fibres.

Occasionally the lower end of the kidney barely reaches below the twelfth rib. In such cases Mr. Morris advises that an upward incision be made over the last rib, a little posterior to the front extremity of the oblique wound.

It is important that the twelfth rib be clearly defined and identified by counting the ribs from above downwards. The last rib is not unfrequently rudimentary, and when the pleura

descends in such a case below the lower edge of the eleventh rib, it may readily be wounded if the incision be carried upwards. This happened in a case reported by Dr. Dumreicher. Dr. Holl has shown that the last rib is often so short as not to reach as far as the outer margin of the sacro-lumbalis muscle, and such a structure may readily be mistaken for the transverse process of a vertebra. Even when the last rib is of normal size, the pleura may descend below it; and this would appear to have been the condition of things in a case of Mr. Thornton's, in which he wounded the pleura, but in which no costal abnormality is noted.

The operation may be somewhat complicated by an excessive amount of subcutaneous fat. In certain cases some of this may be dissected away.

Rigidity and possible thickening of the muscles in some cases of long-standing disease may raise a difficulty in the way of the operation, and a still more serious obstacle may be due to the matting of the tissues together around the kidney. These inflammatory adhesions and organised deposits of plastic lymph may greatly complicate the operation.

Some difficulty has been experienced in finding the kidney through the lumbar incision. Mr. Bruce Clarke mentions a case in which "an hour elapsed before the kidney could be found."

The organ when found may be difficult to deal with. It may be unduly covered by the ribs, or may be firmly fixed by inflammatory tissue to the surrounding structures.

The kidney, on the other hand, may be unusually mobile, it may be difficult to fix, and, when counter-pressure is applied, the organ may repeatedly slip up under the ribs.

b. Detection of the Stone.—The calculus may be very difficult to detect, especially if it be of small size, or if it be lodged in a calyx, or if it be fixed in a very indurated kidney. The kidney often becomes hard and tough under the continued irritation of a stone, and this very hardness of the renal substance should raise suspicion. The kidney may be sacculated, and in one of the sacculi a small stone may fall, and be difficult to find.

The stone may be lost in the rush of fluid which escapes when the pelvis of a much-distended kidney is opened.

Mr. Morris draws attention (*Brit. Med. Journ.*, November 16, 1889) to the following difficulties that may stand in the way of a ready detection of the stone :—

Deposits of tubercle, or even small abscesses, just beneath the renal surface may, from their hardness or outline, give the same tactile sensation as a calculus.

In sacculated kidneys the renal cavity may be wholly or partially filled by a soft mortary phosphatic calculus, which gives no sound nor resistance to the scalpel or needle.

“There is a condition of impaction which absolutely baffles detection,” writes Mr. Morris, “unless by chance the stone is struck on probing the kidney. This is when the calculus is fixed in a recess of the kidney of normal size and consistence, with a thick layer of renal tissue all around it.”

c. Removal of the Stone.—The hæmorrhage from the wound in the kidney may be severe.

When the kidney tissue has suppurated, and the calculus lies in the abscess sac, the operation is usually easy, and the situation of the abscess more or less readily indicated. Difficulty in removing the stone may depend upon a very mobile kidney which is hard to fix, upon the stone being very small or very large, and especially upon the calculus being branched. Very special difficulties will nearly always attend the attempt to remove a large branched calculus embedded in the calyces or near the outlet of the pelvis.

Multiple calculi may give rise to difficulty, as may also a stone situated in the anterior part of the kidney near the entrance of the blood-vessels.

Soft calculi, which break up readily, and which exist rather in the form of a calculous deposit than of a distinct stone, are also very difficult to deal with efficiently.

B.—THE ABDOMINO-LUMBAR OPERATION.

This method, as the name to some extent implies, involves the exposure of the kidney through an incision in the anterior abdominal parietes, and the subsequent removal of the calculus through the ordinary lumbar wound. The operation has little to commend it, but it is described here, as it is still advocated by many.

The kidney is most conveniently exposed through Langenbüch's incision. The details of this operation are given in the section on abdominal nephrectomy (page 507).

The present procedure is conducted upon the following lines :— The abdomen is opened by a vertical incision over the suspected kidney. The hand is introduced into the peritoneal cavity, and both kidneys and both ureters are carefully examined. The calculus is sought for by the fingers of the hand so introduced, and by means of this hand the kidney is fixed, and the colon guarded during the second step of the operation. This step consists in cutting down upon the stone from the loin.

The lumbar incision does not implicate the peritoncum, and may be made of much smaller dimensions than the wound usually required. The opening in the abdominal cavity is primarily for the purposes of exploration and diagnosis, and secondarily it allows of the stone being extracted from the loin with greater readiness and certainty.

This method of nephro-lithotomy was advocated by Mr. Thornton, who has performed the combined operation in ten cases. Of this number, eight recovered, one died, and one was left with a permanent fistula, for which nephrectomy was subsequently performed.

The following advantages have been claimed for this method :— The condition of both kidneys can be ascertained; the stone is detected with greater ease and certainty; there is no fear of an accidental wound of the colon or peritoneum. The lumbar incision is smaller, and there is consequently less risk of extravasation of urine, or of a subsequent lumbar hernia.

The objections urged against the operation are that two incisions are made instead of one, that the peritoneal cavity is opened up, and that the extent and severity of the operation are increased without any corresponding advantage. The advantages of a smaller lumbar incision are practically *nil*, and are negatived when much manipulation is required to extract the stone, and when severe bleeding follows the wounding of the kidney. If the surgeon has one hand in the abdomen, he has only one free for the necessary manipulations in the loin; and in a complex case the single hand would scarcely suffice. It is, moreover, a matter of question whether the stone could be detected as readily through an abdominal as through a lumbar incision.

The operation, I repeat, has very little to commend it.

After-treatment.— This concerns mainly the lumbar wound. If an incision has been made into the abdomen, it is closed by sutures and treated in the usual way.

If the renal wound is left unsutured, and if a drainage-tube has been employed, then for the first few days the whole or the

greater part of the urine secreted by the wounded kidney will escape through the loin. It soon, however, diminishes, and after a period varying from a few days to a few weeks it usually ceases altogether. The wound must be kept very clean. The dressings should be large, dry, and absorbent, and must, so long as urine is escaping, be changed very frequently. To protect the skin, lint spread with boracic ointment or vaseline may be applied over the wound, a hole being provided for the tube to pass through. As soon as the escape of urine has very distinctly diminished, the tube may be gradually shortened, and then finally removed. The wound, as a rule, heals quickly and without complication.

The **results** of nephro-lithotomy have been remarkably good in cases in which the kidney has been otherwise healthy. Newman has collected forty-two examples of such operations without a death. Where suppuration was present, sixty operations were followed by twenty-six deaths, a mortality of over forty-three per cent.

Mr. Henry Morris ("Surgical Diseases of the Kidney and Ureter") gives much larger statistics with very favourable results.

The chief dangers of the operation would appear to be due to hæmorrhage, cellulitis, uræmia, septicæmia, and renal fistula.

2. NEPHROTOMY AND PARTIAL NEPHRECTOMY.

The term nephrotomy is conveniently applied as well to the mere exposure of the kidney through the loin for the purposes of examination, as to the making of an incision into the organ so exposed for certain therapeutic reasons.

Nephrotomy in the latter sense is applied to the treatment of cases of calculous suppression, of simple or hydatid cysts, of hydro-nephrosis, and certain examples of pyo-nephrosis. The operation of puncture of the kidney is dealt with at the end of this section (page 501).

The Operation is carried out in the manner already indicated (page 486). The general circumstances of the operation, the position of the patient on the table, and the instruments required, are all considered in the section referred to.

In Cases of Suppuration.—In some cases of suppuration the presence of redness and swelling may indicate a deviation from the usual incision.

In such instances the tissues between the skin and the kidney will be more or less matted together, and may, indeed, form little more than the wall of an abscess.

When the presence of pus is less distinctly indicated, the kidney is exposed in due course and is examined for evidence of abscess. At any suspicious spot a fine grooved needle may be introduced into the kidney, and be followed, if pus escape, by an incision, and then by dilating forceps.

Thick or caseous pus may be evacuated by the scoop. In any case the interior of the abscess should be explored by the finger. This examination may reveal other abscess cavities or pockets of pus, or may demonstrate the presence of an encysted calculus.

After the evacuation of the pus and the exploration of the cyst, the kidney should be well flushed out with warm sterilised water; a drainage-tube is then introduced up to the kidney. This is packed round with gauze, and the parietal wound is closed around the tube.

In cases in which the kidney is found to be very mobile the organ must be steadied while the abscess cavity is being dealt with; and before the tube is inserted it may be desirable to secure the too movable gland in place by means of two or more deep sutures introduced into the renal tissue.

The after-treatment of these cases differs in no essential from that indicated in nephro-lithotomy.

The tube should be shortened gradually, the dressings must be frequently changed, and the wound cavity be frequently and freely irrigated.

In Cases of Cyst.—The kidney, having been exposed, is steadied and examined. A portion of the cyst wall is denuded of the fatty tissue which covers it, and in some instances the wall so exposed may be brought to the surface and sutured there after having been opened. The opening is made with the scalpel or tenotome, and may then be conveniently enlarged with Lister's sinus forceps or with dressing forceps. As the

contents escape, the cyst wall is grasped with pressure forceps, and is drawn towards the surface. If it cannot be sutured directly to the skin, it may be secured by four or five points of thin catgut suture to the tissues lower down in the depths of the wound. This precaution is wise when the kidney is unduly mobile. When it is firmly fixed in the loin by adhesions, it will suffice merely to open the cyst freely.

In any case, the interior of the cyst should be explored by the forefinger.

A large drainage-tube is introduced, and the parietal wound is closed around it.

The after-treatment of the wound will follow the lines already indicated.

In cases of simple cyst the cavity, as a rule, soon contracts and closes, and the wound heals kindly by granulation. In hydatid cyst a like result may follow after a varying period of suppuration.

When the operation is performed for *hydro-nephrosis* or *pyo-nephrosis* due to some permanent obstruction in the ureter, a persistent escape of urine and pus must ensue. Unless this fistula be treated by nephrectomy, it is well that some receptacle for the discharge from the loin should be employed.

In cases of nephrotomy carried out for *tuberculous disease of the kidney* it is scarcely to be expected that the resulting sinus will close. The abscess cavity should not only be well evacuated, but its walls well scraped.

The extent of the tuberculous invasion will determine the kind of surgical interference. Occasionally the disease may be found limited to one end of the kidney or to one portion of its circumference; in such case excision of a wedge-shaped piece with deep suturing by means of catgut or kangaroo tendon may be successful in removing all the disease, whilst preserving a useful remainder of the organ. In one such case where the lower end of the kidney contained both a tuberculous abscess and a calculus, after bringing the organ out into the wound and making sure that the upper portion was healthy, I excised rather over one-third. There was hardly any leakage of urine from the cut surface, which was sutured with kangaroo tendon.

The tubercle bacilli which had been present in the urine before the operation could no longer be found. In another case one-half of the kidney was degenerated into multiple cysts, and a partial nephrectomy was perfectly successful (J. H.). Mr. Henry Morris and M. Tuffier give several other examples of partial excision of the kidney, and it has been proved that the portion that is left may undergo hypertrophy.

It is, however, exceptional for tuberculous disease, cystic degeneration, or new growth to involve only one segment of the organ, and hence, to justify partial nephrectomy. Nephrotomy, especially incision through the outer border down to the pelvis, has been extensively performed in cases where the symptoms of renal stone have been present, yet none have been found during the operation. A series of such cases will be found in the Middlesex Hospital Reports and in Mr. Morris's work. Sometimes the pain and other symptoms have been relieved by the operation, but as a rule they return, and the proceeding is not without risk. Serious hæmorrhage during or after the operation has even necessitated nephrectomy. Temporary compression of the vessels at the hilum of the kidney should be tried if the bleeding is considerable.

Dragging the kidney out through the wound on to the loin should be avoided when possible. The pedicle is especially short on the right side, and the attempt to stretch it sufficiently to bring the kidney out may tear an important vessel.

On the other hand, nothing that is reasonable must stand in the way of a thorough examination of the kidney. It is surprising with what ease the kidney may be drawn out upon the loin for examination, especially in patients who are thin, and I must confess that I have always freely availed myself of this method of examination, and have had no cause to regret the step.

Of late years Mr. Reginald Harrison and others have advocated "capsulotomy," or simple incision through the sheath of the kidney, in various forms of nephritis. A discussion of this operation is not called for here, especially as its value is still undecided.

Puncturing the Kidney.—The kidney has been punctured with a trocar or aspirator for the relief or cure of hydro- and pyo-nephrosis, large isolated serous or blood cysts of the substance of the kidney, and hydatid cysts.

“The point selected for puncturing will depend on circumstances. If there be any spot over the swelling which is thin, soft, prominent, or fluctuating, the trocar should be there inserted. A point which is not seldom indicated is midway between the umbilicus and the anterior superior spine of the ilium; or half an inch below, and an inch and a half to the side of, the navel. When no particular spot is suggested by discoloration or prominence, no better place can be selected on the left side than an inch in front of the last intercostal space; but if the tumour be of the right side, this is too high, as the liver would probably be traversed. If there is no indication for operating elsewhere, the best spot to select when the kidney is of the right side is half-way between the last rib and the crest of the ilium, between two and two and a half inches behind the anterior superior spine of the ilium.

“The dangers of the operation are very slight. If, however, the puncture be made too far forwards, and through non-adherent peritoneum, some of the contents of the cyst might be extravasated into the peritoneal cavity on withdrawing the cannula, an accident which has proved fatal in more than one case. There is also the danger of wounding the intestine, which, as a rule, is in front of and adherent to the tumour; and if the trocar be long, and be thrust too far inwards, it might penetrate some important blood-vessel, and cause dangerous, if not fatal, hæmorrhage. The penetration of the thin edge of the liver with an aspirating needle, though to be avoided, is not an accident likely to be followed by any ill consequence. The instrument should not be introduced too near the ribs, for fear of wounding the pleura.” (Morris.)

There is nothing to commend this procedure. It is uncertain, unsatisfactory, very often absolutely useless, and, as the above account will show, not without danger.

It can be but very rarely, indeed, that this method is justifiable. A lumbar incision which enables the operator to fully expose and examine the tumour and to deal effectually with it is much to be preferred.

3. NEPHRECTOMY.

The operation of removing or excising the kidney has been performed for tumour of the kidney, for renal or ureteral fistula, and for disorganisation of the organ by injury, tuberculous disease, suppuration, or urinary infiltration. Nephrectomy has also been carried out in cases where nephrotomy or nephro-

lithotomy has failed, and in certain examples of movable kidney.

Nephrectomy may be performed in two ways:—

- A. By incision through the loin—lumbar nephrectomy.
- B. By incision through the anterior abdominal parietes—abdominal nephrectomy

A. LUMBAR NEPHRECTOMY.

Instruments Required.—Scalpels; bistouries; dissecting, artery, and pressure forceps; large pressure or clamp forceps, straight and angular; broad metal rectangular retractors; blunt hooks; stout aneurysm needle in a long handle; pedicle needle; silk, kangaroo-tendon, and catgut ligatures.

The **position** of the patient, and of the operator and his assistants, is the same as has been already described (page 486). The hard pillow under the loin should be used, in order to extend the space between the last rib and the iliac crest.

(1) **Exposure and Isolation of the Kidney.**—The incision made is the same as has been already described in the account of nephro-lithotomy (page 487). Through this incision the kidney is exposed, and through it an organ of normal size may be removed.

When the organ is reached and has been superficially examined, it will usually be found necessary to enlarge the original incision. This may be done in many ways.

The oblique incision may be extended to the full length admitted by the conformation of the individual. This incision will suffice for all cases in which the lumbar operation is allowable. If a greatly-increased lumbar incision is called for, then, in my opinion, the lumbar operation is not permissible.

Morris advises that to the original cut be conjoined a second incision, running vertically downwards from the first, and starting from it about one inch in front of its posterior extremity (Fig. 418, B). This second incision is left until the kidney has been reached and explored, and is made by cutting from within outwards with a blunt-pointed bistoury, guided by the index

finger of the left hand. This vertical incision affords increased facility for dealing with the pedicle (page 504).

The position of the vertical incision with reference to the original oblique cut may be modified according to circumstances. It may be more convenient that it should start from the centre of the oblique cut, or from its actual posterior extremity.

Other incisions, more or less closely resembling the above, have been advised or carried out.

Some surgeons carry a short transverse incision forwards from the lower end of the oblique one. The actual form of incision is a matter of little moment, provided that sufficient room is obtained and that the peritoneum is not opened. Prof. Koehler, however, advocates as a preliminary measure opening the peritoneum at the lower and front end of the wound sufficiently to enable the surgeon's hand to explore the opposite kidney and to ascertain that it is of normal size. The wound in the peritoneum can then be sutured and the operation proceeded with. This method is not infallible, and may add materially to the risk.

König divides the soft parts vertically along the border of the erector spinæ down to a point just above the iliac crest. He then curves the incision forwards towards the umbilicus, and ends it at the outer border of the rectus muscle. (Fig. 418, c). All the muscles are divided down to the peritoneum. The vertical part of the wound is completed first, and the fingers being introduced, the peritoneum is detached and is pushed forwards, so as to be free of the anterior part of the incision when that comes to be made.

This incision—known as the retroperitoneal lumbo-abdominal incision—gives plenty of room, but it is needlessly extensive. It involves a very considerable division of muscular fibre, and is very likely to be followed by a ventral hernia. When any such an extensive exposure of the renal region is called for, it is better that the anterior abdominal incision should be employed.

The kidney is exposed in the manner already described (page 487).

It is now necessary to examine it and to separate it from

its connections. Good broad rectangular retractors should be used, so as to expose the parts well, and an assistant should at the same time press the kidney into the wound by the hands applied over the front of the abdomen. If there have been no inflammation in the perinephritic tissue, the separation of the kidney is easy.

The fatty tissue around the kidney can readily be detached by means of the index finger of one hand introduced into the depths of the wound, and swept round the organ in close contact with its capsule. In this manner the gland is readily enucleated and isolated.

Even when no inflammation has occurred, it is possible—as Mr. Morris points out—that some of the renal capsule may be torn off and left behind when this manoeuvre is carried out. When there has been much inflammation, as in cases of calculous or tuberculous pyo-nephrosis, the tissue surrounding the kidney will be found condensed and adherent, and the enucleation of the organ will then be difficult or in some few cases impossible. In such case the kidney should be enucleated from its thickened and firmly adherent capsule, and the latter left behind with the pedicle. In effecting this enucleation, a flat hernia director will be found to be of service. The only guide in such enucleation is the exposed kidney tissue itself.

It may be possible, in some of these cases, to isolate the kidney, together with its capsule, entire, by means of cutting—scissors curved on the flat being employed for the purpose—but the satisfaction of removing every trace of the disease is hardly sufficient to justify the risk incurred by such a proceeding.

In any instance, the enucleation must be conducted with caution; the capsule may be stripped off in one place, and the adherent tissue cut through in another. The kidney must not be violently torn out; and, indeed, in such cases, but little traction can be brought to bear upon the organ.

When the kidney has been already exposed by a previous operation, it will probably be easier to enucleate the organ from its own capsule than from the perinephritic fatty tissue.

(2) **Treatment of the Pedicle.**—The kidney, having been freed, is drawn as far out of the wound as possible, and the

pedicle is isolated with the fingers, and examined carefully. To obtain more room, the lower ribs may be drawn forcibly upwards with a strong retractor.

When convenient, an assistant may draw the kidney forwards while the surgeon deals with the pedicle.

The individual structures in the pedicle should be exposed and isolated as far as is possible by rapid dissection. The ureter is well isolated, and secured between two ligatures. The vessels are then secured separately, or in as small bundles as possible, the arteries first and the veins afterwards. Stout silk is used to secure the pedicle, and it is conveniently passed by means of a stout aneurysm needle. The ligatures on the vessels should be applied as far from the kidney as is possible.

As each ligature is being drawn tight, all traction upon the pedicle must be taken off.

The pedicle is now divided with blunt-pointed scissors close to the hilum of the kidney.

Before severing the pedicle, some surgeons apply a separate single ligature around the whole of the already ligatured parts.

The kidney is now removed.

The pedicle is examined. Any bleeding point detected should be at once seized with pressure forceps, and secured later. Such hæmorrhage may depend upon the existence of aberrant or abnormal branches that have escaped the ligatures on the pedicle.

The ureter is now examined. If it appears healthy, it is left as it is, securely ligatured. If it be dilated and occupied with foul or tuberculous pus, then as much of the tube as can should be excised above a ligature applied as low down as possible.

Silk is the most convenient material for the ligature of the pedicle, but other substances have been used with success, and notably, among them, kangaroo tendon.

The attempt to ligature the artery and the vein separately is in some instances impossible.

The possible existence of abnormal veins and arteries must always be borne in mind. These vessels may escape the clamp or the ligature, and yet be severed when the kidney is removed.

In more than one recorded case, fatal hæmorrhage has resulted from this cause.

In the event of bleeding persisting after the kidney has been removed and the pedicle tied, the wound must be well exposed, dried, and illumined. In nearly every instance it will be possible to pick up the bleeding vessel with pressure forceps, and subsequently to tie it. If the hæmorrhage persists, and it is impossible to secure the bleeding point so, the wound must be well plugged from the bottom with gauze, which is kept in place by firm bandaging.

The wound in the parietes is now closed by sutures. These should be of silkworm gut, and should be passed deeply, so as to embrace the various layers of tissue divided. A few superficial sutures will in addition be required. A drainage-tube is introduced if necessary into the depths of the wound, and the part is dressed in the usual way, and is supported by a firm flannel bandage. In a large proportion of cases no drainage-tube is required.

Complications of the Operation.—It may be found to be impossible to remove the kidney after it has been exposed.

This is most likely to occur in cases of malignant disease, and in those of pyo-nephrosis with extensive adhesions to duodenum, colon, pancreas, vena cava, or liver. With regard to the malignant growths, nephrectomy is of very doubtful value, and hence if the removal of the kidney seems likely to risk the patient's life, it is best to abandon the attempt. Few operations are so anxious and difficult as removal of a large suppurating kidney universally adherent, and the wound in such case will require free provision for drainage.

If, when the kidney is exposed through the loin, it is found to be of so great size as to render removal through the lumbar incision doubtful, it is far better to perform the abdominal operation than persist at all hazards in the attempt to extract the organ from the loin.

There is nothing whatever to recommend the advice that in these cases, after the vessels have been secured by a temporary ligature, the kidney should be cut away in separate portions. Such a proceeding is to be condemned.

When the pedicle is very short and thick, and perhaps overlapped by the kidney, clamps with long narrow blades should be applied, and then the kidney itself be cut away well in front of it. After the removal of the diseased organ the stump can be brought into view, the vessels can be secured by separate ligatures conveniently applied, and the stump trimmed by removing as much tissue as the position of the ligatures will allow.

Should the peritoneum be wounded or torn in removing the kidney, the rent should, if possible, be sewn up with a catgut suture.

After-treatment.—The patient must be kept in the recumbent position until healing is complete. The drainage-tube may be removed on the second day in most cases, but it is well to retain it considerably longer when the operation has been specially difficult, when an abscess has been encountered, or when from infection of the perirenal tissues some suppuration is certain to occur. The wound usually heals well, although some three or four weeks may elapse before the drainage-track is perfectly closed. The recumbent position should be insisted upon until the healing is firm.

B. ABDOMINAL NEPHRECTOMY.

The list of instruments required has already been given (page 502). The operation is conducted upon the general lines observed in other abdominal operations. The preparation of the patient, and the general disposition of the patient, the surgeon, and his assistants, have been considered in a previous section (page 225 *et seqq.*).

The Operation.—The incision is vertical, is made in the semilunar line, is about four inches in length, and is commenced just below the margin of the ribs. The centre of the incision will probably be about the level of the umbilicus. The abdomen is opened, the cut peritoneum on either side is picked up with pressure forceps, and when all bleeding has been checked the hand is introduced.

The following are now the steps of the operation :—

- A. Examination of the opposite kidney.
- B. Establishment of the coffer dam.
- C. Isolation and separation of the kidney.
- D. Isolation of the pedicle and demonstration of its component parts.
- E. Ligature of the pedicle.
- F. Removal of the kidney.
- G. Disposal of the Ureter.

A. As a first measure the hand is passed across to the opposite side of the body, and the opposite kidney carefully examined. If this organ be found to be extensively diseased, or if it be discovered that the patient has but one kidney, then the nephrectomy must needs be at once abandoned.

The kidney on the affected side is now examined, its size is estimated, its general characters as regards mobility, consistence, etc., are ascertained, and the condition of its pedicle is demonstrated.

The small intestines are kept aside by slightly tilting the body to the opposite side.

The colon is made out, and is pushed towards the median line. The surgeon then incises the outer layer of the mesocolon vertically over the renal region. Into the rent thus made the fingers are introduced, and the kidney is laid bare.

B. Pressure forceps are made to grip the peritoneum on each side of this rent in the mesocolon. The forceps—some six on each side—are then lifted up and lift up the two edges of the peritoneum with them, as one would lift up the mouth of a sac. The margins of the rent in the mesocolon are, indeed, drawn up until they reach the margins of the skin wound. The kidney lies exposed at the bottom of the peritoneal bag thus produced. It is within this bag that the whole operation is carried out, the peritoneum being freely separated, so as to give plenty of room. The operation is thus carried out within a species of coffer dam. If the forceps be properly adjusted, the operation is extraperitoneal. The general peritoneal cavity is shut off. If the kidney contains an abscess and that abscess

bursts during removal, it bursts into the coffer dam, and is quite isolated. Any bleeding also is limited by the walls of the coffer dam, and must remain extraperitoneal. I have never found any difficulty in maintaining this coffer dam intact during the whole of the operation. It has the advantage also of preventing any coil of small intestine from appearing in the operation area.

c. As soon as the coffer dam has been made secure, the kidney is exposed, and is well and thoroughly isolated all round. This separation is to a great extent effected by the fingers, which keep throughout very close to the capsule of the gland. Now and then the seissors are needed to divide resisting bands, and sometimes the scalpel is required. The most difficult part of the kidney to free is the upper end, and that should be dealt with last. Care must be taken to leave the suprarenal body behind. When the kidney is very adherent, this process of separation is very tedious. Free use of the seissors may be demanded. The chief rule is to keep always close to the kidney, and to be careful of the vessels when the hilum is reached. There is no objection to the leaving of parts of the capsule behind, but it should be avoided whenever possible.

d. When the kidney has been well and entirely freed, the next step is to free the pedicle. This must be done by pushing the peritoneum towards the median line. The pedicle must be isolated on all sides, in front, behind, above, and below. Some dissection will be needed to make this separation complete. The next step in the operation is the isolation of the component parts of the pedicle. This is done when the kidney has been drawn well outside the abdominal wound. The kidney is dragged upon and the pedicle displayed from all sides. The isolation of the ureter and chief vessels is effected by dissection with scalpel and forceps, and with the forceps and the blunt dissector. On the right side the very close position of the vena cava must be borne in mind. Adhesions may render this part of the operation very difficult.

e. The pedicle is now tied in segments. The ureter is first isolated, and is at once severed between two strong silk ligatures. To the lower ligature a pair of pressure forceps are attached as a guide. The vessels of the pedicle are now tied separately or

in small bundles by means of fine silk. The arteries are secured before the veins. An aneurysm needle is useful at this stage. The tension on the pedicle is relaxed as the ligatures are drawn tight. Before the pedicle is divided one or more clamps may be applied to the pedicle tissues on the proximal side of the ligatures.

F. The pedicle is now cut through with scissors. To prevent an escape of blood from the kidney, the vessels may be clamped on the kidney side of the intended line of section. The kidney is now free, and is removed. The surgeon then returns to the pedicle stump. He removes any clamp forceps which may be in position, and applies additional ligatures if necessary.

G. The surgeon now seeks for the divided ureter. If it be healthy, nothing remains but to cut the ligature on it short, and drop it back. If it be dilated or contain pus, as much of the tube as can be removed should be removed. It should be ligatured, and the cut end exposed beyond the ligature should be very vigorously scraped with a Volkmann's spoon. It may be necessary to examine the ureter for a calculus, and to remove such calculus if found. I have met with no instance in which it appeared to be necessary to bring out the divided end of the ureter through an incision in the loin. No circumstances would justify the bringing of the divided end of the ureter out at the anterior abdominal incision.

The cavity left by the removal of the kidney is well cleaned out, and if any septic matter is likely to have found its way into it, the whole cavity is well washed out with a weak and warm antiseptic solution. When the operator has convinced himself that all oozing has ceased, and that the operation area is absolutely clean, the wound in the parietes may be closed in the usual way, and a suitable dressing applied. No drainage is required.

If, however, any septic matter has escaped into the cavity left by the removal of the kidney, then drainage should be employed. The drainage-tube is best carried through the loin at a convenient spot close to the anterior or outer edge of the quadratus lumborum muscle.

There is no need to close by sutures the rent made in the peritoneum.

Comment.—In dealing with cysts of the kidney, with cases of pyo-nephrosis, and with such tumours as are represented by soft sarcomata, it is very important that the capsule of the gland be not opened.

In a case operated on by Czerny, the capsule was broken through, and the soft sarcoma growing within was laid bare. A profuse hæmorrhage ensued, which could only be arrested by temporary compression of the aorta, and which returned as soon as this was taken off. The aorta was finally ligatured. The bleeding ceased, and the patient lived ten hours.

In this operation, when on the right side, the close proximity of the vena cava must be borne in mind. In one case Mr. Thornton accidentally included a small piece of the vena cava in the pressure forceps, which had been applied about the renal vessels. When the vessels were divided, a small V-shaped piece was cut out of the wall of the vena cava, and the patient bled to death.

Some cases of wound of the vena cava have, however, recovered after a lateral ligature had been applied. One such case occurred to me, and no trouble followed the tying up of the hole, as one would tie up a hole in a bag. Bleeding from a wound in the vena cava is very gentle, and during inspiration it practically ceases. During expiration the blood wells up slowly. In one instance in which adhesions about the pedicle were very troublesome, I had to cut a little into the vena cava; the amount of the great vessel taken up by my ligature caused œdema of the legs for nearly six months. The patient was a middle-aged woman, under the care of Dr. Seivers—who was present at the operation—and the kidney was removed for old tuberculous disease. Beyond the œdema of the legs, no inconvenience whatever followed upon this narrowing of the great vein.

On account of the nearness of the vena cava and the overshadowing of the liver, removal of the right kidney is more difficult than the removal of the left.

It is always desirable to separate the kidney before the pedicle is dealt with.

The rough clamping of the pedicle and the inclusion of it in one heavy ligature is to be condemned. There is no difficulty in isolating the vessels and securing them individually.

The diaphragm has been torn in clearing the upper end of a very adherent kidney.

The parietal wound should be free, and be enlarged as required.

The incision in the mesocolon should be made at least one inch from the bowel. When no mesocolon exists, the incision is made in the parietal peritoneum to the outer side of the colon. In such case the coffer dam is not easily maintained, as the peritoneum is apt to be too scanty.

The **after-treatment** resembles that observed after other abdominal operations. It is well, however, to avoid opium if possible. The bowels should be opened on the fourth day.

OTHER METHODS.

1. **By Median Incision.**—The abdomen is opened in the median line, the intestines are pushed well over to the opposite side by means of sponges, and the kidney is exposed. The colon is displaced to the outer side, and the mesocolon is opened through its inner layer. The rest of the operation does not differ materially from that just described.

When compared with the lateral operation, that procedure may claim the following advantages over the method of the median incision:—

In the lateral operation the kidney is more directly exposed, and the pedicle is more easily reached; the peritoneal cavity is less extensively exposed; the kidney is reached through the outer layer of the mesocolon, and therefore the main colic vessels are not met with, and consequently not exposed to damage.

The median operation has one trifling advantage—the opposite kidney can be more readily examined.

2. **By Lateral Extraperitoneal Incision.**—This operation is performed as follows:—A vertical incision is made from the anterior superior iliac spine up to the eighth rib. The various layers of the parietes are cut through until the peritoneum

is reached. This membrane is not incised, but is stripped up from the iliac fossa, and from the anterior surface of the kidney, and is displaced inwards.

The kidney is thus exposed, and the pedicle is dealt with in the usual way.

No advantage whatever can be claimed for this method. The wound is deep, and the risk of ventral hernia is increased. The fact that the peritoneum is not opened is the only point that can be urged in support of the procedure.

COMPARATIVE VALUE OF LUMBAR AND ABDOMINAL NEPHRECTOMY.

The advantages and disadvantages of these two methods of operating may be expressed as follows:—

Lumbar Nephrectomy.—*Advantages.*—The peritoneum is not opened. Excellent drainage can be provided should drainage be required. If putrid pus escape, the area infected is comparatively small.

Disadvantages.—The wound is small, and the operation area is very narrow and confined. The operation is difficult in the corpulent. There is some danger of wounding the pleura. The kidney is not always very easily found. The peritoneum, the colon, and on the right side the vena cava are in danger when extensive anterior adhesions exist. The pedicle is much less easily reached and much less safely secured. The kidney is more likely to be torn in the act of removal. The operation is not adapted for large tumours. Above all, the opposite kidney cannot be examined.

Abdominal Nephrectomy.—*Advantages.*—Ample room is provided, and the kidney is readily found, examined, and dealt with. The pedicle is easily reached and easily dealt with. If the incision be in the semilunar line, a series of muscular planes is not divided. The opposite kidney can be examined. Tumours of any size can be removed.

Disadvantages.—The peritoneum is opened. Unless a second incision is made in the loin, efficient drainage is not provided should drainage be required. The disposition to a ventral hernia is probably greater than is the case in lumbar nephrectomy.

In my opinion, abdominal nephrectomy is infinitely the better and more satisfactory of the two operations, and for some years past I have practised it exclusively. I think that the abdominal operation is as superior to the lumbar as is inguinal colotomy to lumbar colotomy.

Results of the Operation.—In general terms, the mortality attending the operation of nephrectomy may be placed at about 15 to 20 per cent.

Death has been due to shock, to hæmorrhage, to uræmia and anuria, to peritonitis, and to the results of septic inflammation.

4. NEPHRORAPHY.

This operation is practised in exceptional cases of floating, movable, or wandering kidney, in which the organ is the seat of severe and spasmodic attacks of pain, due to torsion of the pedicle. It is occasionally also employed in special cases in which there is more or less continuous discomfort, and in which all other measures—such as the use of trusses and belts—have failed.

The operation was at one time somewhat indiscriminately employed. It should be restricted to the exceptional case.

The Operation.—The kidney is exposed through the loin in the manner already described (page 486). When reached, it is well forced into the wound by an assistant, who presses upon it with both hands applied over the anterior abdominal wall. The fatty capsule is well opened up. Often very considerable difficulty will be experienced in fixing an unusually mobile organ. I have found it necessary to fix the kidney with a tenaculum while the first suture was being applied.

Prof. Hahn, who was the first surgeon to perform nephroraphy, in his earliest operations simply passed sutures into the fatty capsule of the kidney. This proved unsatisfactory, as might have been expected. Various forms of suture—silk, silkworm gut, kangaroo tendon, chromicised catgut, and even one of the tendons from the patient's erector spinæ have been employed. The following method is recommended as giving satisfactory results.

The posterior surface of the kidney in its capsule is thoroughly exposed and brought into the wound. A curved needle charged with fairly thick kangaroo tendon is passed through the muscular and aponeurotic edge at the upper end of the wound, and then, carefully avoiding the peritoneum, is made to pierce the upper part of the kidney. The needle dips into the kidney substance for half an inch or less, and emerges from one to two inches from its point of entrance, so that the ligature gets a wide hold on the kidney. The needle is then passed through the opposite edge of muscle, and the loop is held in a pair of pressure forceps. A second and third suture is similarly introduced below the first one, traversing the middle and lower parts of the kidney. Four and even five such sutures may sometimes be employed. The patient is then turned almost into the supine position and the sutures are knotted securely one by one, without employing such force as would risk their cutting through. The kidney tissue is very soft, and the sutures are readily made to cut through unless tied very gently. If necessary, one or more buried sutures of tendon may be employed to close the wound in the muscles still further.

There is no necessity to introduce the sutures deeply into the renal cortex, and there should be no risk of passing one into the pelvis or one of the calyces. The superficial part of the wound is closed with silkworm gut. Drainage is not required.

Some surgeons consider it advisable to divide the renal capsule in order to get firm adhesions, and in the method given above this may be done vertically after the sutures have been passed, but before they are tightened. Experiments on animals, however, show that splitting the capsule, etc., does not lead to such satisfactory adhesions as its careful fixation when intact by sutures. This is confirmed by the following statistics given by Albarran from the human subject:—

	Cases.	Successful.
Fixation of the floating kidney by means of sutures traversing the intact fibrous capsule	161	81%
Fixation with reflection of the capsule ..	75	77%

The widespread belief that exposing the renal cortex by reflecting the capsule will in itself lead to granulations and

firm scarring is quite unfounded; in fact there is no other way of securing a floating kidney in place except by sutures, which should take hold of the posterior surface from one end to the other. The troublesome complications that may follow the use of silk for this purpose have led to the proposal to employ an animal suture—obtained from the patient's erector spinæ. Kangaroo tendon, however, is much to be preferred, and hardly ever causes trouble.

When a long tendinous slip of the erector spinæ is utilised, it is divided across, leaving its upper and lower attachments; the ends are then passed vertically beneath the capsule and knotted together. This plan seems to be very inferior to the one described.

Fixing the kidney to the last rib involves a slight risk of penetrating the pleura, it has no special advantage, and has sometimes led to a fatal issue.

Silk sutures, when introduced with the idea of being permanently retained, have in a few instances excited suppuration, and have led to troublesome sinuses. They appear also to have often caused much long-continued renal pain.

Catgut sutures have proved untrustworthy, having been too quickly absorbed.

The plan of fixing the kidney by means of catgut sutures which merely included the capsule, and of then stuffing the wound from the bottom with gauze to induce granulation, has not proved trustworthy.

After-treatment.—The treatment of the wound is conducted upon the usual lines. It is essential that the patient should rest in the recumbent position for a period of not less than four to six weeks after the operation. During convalescence the colon should be kept empty, and after the patient gets up, a supporting belt should be worn for some few months.

Results.—Dr. Keen has collected 134 cases of nephrography. Of this number four died, representing a mortality of 2·9 per cent. Of 116 cases reported in detail, and reviewed after a period of at least three months, 57·8 per cent. were cured, 12·9 per cent. were improved, and 19·8 per cent. failed. Tuffier and Morris in more recent statistics give similar results.

The cases treated by suture of the fatty capsule only, present 26·6 per cent. of failures ; those treated by suture of the fibrous capsule yield 25·9 per cent. of failures ; while in those treated by suture involving the kidney substance, the failures are represented by 13·5 per cent.

5. URETERO-LITHOTOMY.

A calculus may be impacted at the junction of the renal pelvis with its ureter, at the vesical orifice, or at any point between these two. Hence no fixed rules can be laid down for its extraction. In the majority of cases the stone should be cut down upon in the lumbar region through an incision made as for nephrotomy, commencing at the angle between the erector spinæ and the last rib, and passing downwards to the iliac crest. The Röntgen rays should always have been used beforehand, and the position of the calculus ascertained as far as possible. The lower end of the kidney and the pelvis having been identified, the calculus is sought by palpation. If it can be detected in or near the renal pelvis, the latter is incised, care being taken to avoid any aberrant renal vessels (it is quite common to find one or more branches of the renal vessels passing *behind* the upper end of the ureter). A gush of urine ensues, and the finger, being introduced, will perhaps succeed in extracting the stone aided by pressure from below with the left hand. A small lithotomy scoop or forceps such as are used in cholecystotomy may be required, and the forceps should have a secure grip to prevent the stone from slipping out of their grasp.

If the calculus be fixed in the ureter too low down to allow of its being pushed upwards into the pelvis, the ureter should be incised in its long axis directly over the stone, which may be reached from the loin as low as the upper part of the iliac fossa.

If, however, it is previously known that a calculus is impacted within a few inches of the bladder, an incision should be made similar to that used for ligature of the common iliac artery. This incision is made just above and parallel to the outer half of Poupart's ligament, curving upwards and slightly

inwards when it reaches the level of the anterior superior spine. The abdominal muscles and transversalis fascia are divided in this incision until the subperitoneal fatty layer is reached; the peritoneum is then gradually pushed inwards until the ureter is reached as it crosses the bifurcation of the common iliac artery. Its identification will probably be rendered easy by its distension with urine; the distended part may measure two inches or more in diameter. Whilst his assistant presses aside the peritoneum, the operator opens the ureter longitudinally, and after the urine has escaped into a sponge held ready for it, he passes a bent pair of forceps down to grasp the stone. If the patient be a woman, the manipulation will be much aided by the index finger of the opposite hand in the vagina pushing upwards and steadying the stone. The stone is usually elongated, with its long axis, of course, in the line of the ureter. Should the patient be thin, the ureter will probably be reached with ease, and the extraction of the stone may present no difficulty. Far otherwise is it if the patient be stout, for the search for a small calculus at the depth of some eight inches of fat from the surface, whilst venous oozing is continuous, may tax the resources and patience of the operator to the utmost.

It is needless to say that under such unfavourable circumstances no attempt should be made to suture the wound in the renal pelvis or ureter; but in ordinary cases this may be done with success, and such suturing should be employed as a routine measure. In any case due provision should be made for drainage of the wound.

In order to expose the greater part of the ureter from the renal pelvis down to near the bladder, a very long incision (lumbo-ilio-inguinal) is advocated by Mr. H. Morris. This incision commences under the last rib, passes forwards and downwards across the ilio-costal space, curves round the iliac crest one inch to the inner side of the anterior superior spine, runs parallel with Poupart's ligament, and ends nearly at the external abdominal ring.

The peritoneum must on no account be opened, and the spermatic vessels in the male, the ovarian in the female, must

be carefully avoided. If an impacted stone be detected it should, if possible, be pushed upwards into the dilated portion of the ureter, which is then incised. After the removal of the stone, the incision in the ureter is closed by sutures.

6. PYELOTOMY OR URETEROTOMY FOR VALVULAR OBSTRUCTION.

In these cases the site of the obstruction is almost always near the kidney, where the pelvis ends in the ureter. Hence a long incision, such as the one just described, is unnecessary. The site of the obstruction having been well exposed, the dilated portion above is incised. "The opening of the ureter into the sac should be looked for, but cannot always be found, as in some cases it is very narrow. In such cases it may be treated by incising the ureter below the sac, and passing a probe upwards towards the pelvis. The valve or inner wall of the ureter is now divided longitudinally from the opening in the sac." The wound thus made is sewn up in a similar way to that used in pyloroplasty, so that what was a longitudinal becomes a transverse line. Fine silk on curved needles should be employed. The supposed danger of calculous matter being deposited in such sutures appears to be largely imaginary. Plastic operations of this nature performed for the cure of hydro-nephrosis may fail, but in cases of valvular obstruction they should certainly be tried with the hope of avoiding nephrectomy in those cases in which any healthy kidney tissue remains.

Part X.

OPERATIONS ON HERNIA.

CHAPTER I.

OPERATION FOR STRANGULATED HERNIA.

THE operation for strangulated hernia is not only very frequently performed, but it ranks also as one of the urgent measures of surgery which often need to be carried out at a moment's notice, and possibly under unfavourable conditions. The operation itself is comparatively simple, and needs for its performance but few and simple instruments.

The mortality of the procedure, however, is higher than would at first sight appear probable. In the practice of large hospitals the death-rate will stand at nearly 30 per cent.

This fact depends not upon the gravity of the operation itself, but upon the condition of the patient at the time of treatment. In numerous cases the hernia has not been discovered; in many the early management of the case has been unwise, taxis has been persevered with unreasonably, and the question of operation has been too long postponed.

Of 140 consecutive cases of strangulated hernia that I (J. H.) operated upon in the London Hospital between the years 1890 and 1899, the results were as follows (*Clin. Soc. Trans.*, 1900, p. 77):—

Inguinal	..	..	65 cases	..	54 recovered, or 83 per cent.
Femoral	..	..	54	..	40 „ „ 74 „
Umbilical	..	..	21	..	12 „ „ 55 „

Of the total number, there were 106 recoveries and 34 deaths, a mortality of 25 per cent.

In the fatal cases death was generally due to the acutely

inflamed or gangrenous condition of the hernial contents at the time of operation.

Mr. W. Thorburn (*Brit. Med. Journ.*, April, 1903) has given his own statistics from the Manchester Infirmary. They cover the same period of time, and include 110 cases:—

Inguinal	..	..	55 cases	..	40 recovered, or 73 per cent.
Femoral	..	..	37 "	..	29 " " 79 "
Umbilical and					
Ventral	..	..	18 "	..	14 " " 78 "

Mr. Thorburn quotes the added statistics of St. Bartholomew's, the Middlesex, and St. Thomas's hospitals for a like period:—

Inguinal	..	496 cases	..	397 recovered, or 80 per cent.
Femoral	..	485 "	..	365 " " 75 "
Umbilical	..	109 "	..	60 " " 55 "

The total mortality in this series of 1,090 cases was 268, or 25 per cent.

The close correspondence of these various percentages is noteworthy, and it may be accepted from the evidence of the 1,340 cases of operation for strangulated hernia of all kinds that the death-rate is 25 per cent. It will be seen that the mortality is lowest in inguinal hernia, higher in femoral, and reaches its maximum in cases of umbilical hernia.

The operation itself can carry with it very little danger; it is the delay that is fatal.

The mortality will unquestionably become lower in proportion as the operation is carried out early and a mistaken expectant treatment is abandoned.

In the early part of the last century the great question in connection with the operative treatment of strangulated hernia was whether the sac should be opened or not.

The introduction of improved methods of treating wounds has rendered this of no importance. In all cases, without exception, the sac should be opened.

Instruments Required.—A scalpel and hernia knife; dissecting forceps; fine-toothed forceps; pressure and artery forceps; blunt-pointed bistoury; hernia directors; blunt

hooks; needles; scissors; sutures. In the event of its being necessary to resect a portion of the prolapsed intestine, clamps, intestinal needles, and suitable sutures should be at hand.

The hernia knife should be as simple as possible (Fig. 420), and should have a short cutting edge. "Guarded knives," "herniotomes," and other complex instruments for dividing the stricture should be avoided.

The two most convenient directors for the stricture are those known as Cooper's and Key's. (See Fig. 339, page 177.)

Preparation and Position of the Patient.—The skin over the area of the operation must be thoroughly cleansed and washed with an antiseptic solution.



Fig. 420.—COOPER'S HERNIA KNIFE.

When the region of the groin is concerned, the hair on the whole of the pubes and on the serotum or labium must be shaved away.

It is well that the bladder should be emptied. In long-standing cases, in which there has been fæcal vomiting, it is very desirable that the stomach should be emptied and washed out. This is the more necessary when the activity of the natural reflexes has been depressed by opium. In such cases the stomach may contain pints of fæulent fluid; and with this poisonous compound still in the viscus, the patient may be sent back to bed after the operation.

In the worst class of case the foul contents of the stomach gush forth by the mouth and nose as soon as anæsthesia is established, and death often follows thereon. The washing-out of the stomach may be accomplished either before or after the operation, and when the patient is wholly or partially anæsthetised.

In the severest cases it is perhaps safest to do it before the herniotomy. Considerable relief follows this measure, and the shock is often distinctly modified by flushing the stomach with warm or hot water.

The best apparatus to employ is a syphon irrigator, and after the organ has been emptied some pints of water at a temperature of 100° F. can be passed through the stomach. I have found no difficulty to attend this measure, nor is much time occupied in its execution. With the beneficial results I have been distinctly satisfied. If the washing is carried out after the operation, *e.g.* while the dressings are being applied, it is often to be noted that the after-vomiting due to the anæsthetic is greatly lessened, or even absent.

The patient's limbs and chest should be protected by blankets covered with macintosh sheets. Every care must be taken to avoid exposure to cold, and it may even be well to have a few hot bottles in contact with the body during the operation in cases attended by much collapse.

The patient lies upon the back, close to the right-hand edge of the table. The surgeon stands on the same side of the patient as the hernia.

Before the operation is commenced, it is well to wedge some aseptic packing between the patient's buttock and perineum and the table. This packing will absorb any fluid which may find its way towards the perineum, and will save much of the time usually devoted to the cleaning of the patient after the operation has been completed.

THE OPERATION.

The general details of an operation for strangulated hernia will now be described. The special features that belong to the herniæ of particular regions will afterwards be dealt with. The operation may be conveniently considered under these headings :—

1. Exposure and opening of the sac.
2. Division of the stricture and the treatment of the contents of the sac.
3. Treatment of the sac and the closure of the wound.
4. Treatment of complications.

1. **Exposure and Opening of the Sac.**—An incision is made over the neck of the sac, and as a rule in the long axis

of the tumour. This incision should be placed as far from the genital region as possible; thus in the case of inguinal hernia it should not encroach on the scrotum. The various layers between the integument and the sac are divided by clean and precise cuts that involve the whole length of the incision. Any vessels that are liable to be divided are secured with pressure forceps.

There is no need to use a director in dividing the tissues which cover the sac, and that dangerous instrument can very well at this stage be dispensed with.

It is needless to say that the various precise anatomical coverings of the sac cannot be identified as they are divided. The subcutaneous tissue can of course be recognised, and in the inguinal region the intercolumnar fascia and the cremasteric fascia can often be made out; but beyond this the surgeon will be but little reminded of the coverings which are so elaborately displayed in the dissecting-room.

“The great mistake in one’s first operations,” writes Sir William Banks, in dealing with the exposure of the sac, “is in thinking that the sac has been reached long before it has. In this way two or three extensive strippings are often made, and then, after all, another layer or two are found. By these strippings the cellular tissue is torn up, as a result of which troublesome sloughing and suppuration are apt to occur.”

The incision should be sufficient in size, and may be enlarged with a probe-pointed bistoury as occasion demands.

Many means of recognising the sac, when it is exposed, have been given. Not a few of these are fallacious and uncertain. The “shining surface” and the “arborescent vessels” of the older text-books will be found to be false guides. The *inner* surface of the sac is smooth and shining, and when such a surface is demonstrated and fluid escapes, it is more than probable that the sac has been opened. There may, however, be no fluid in the sac, as is often the case in umbilical herniæ; and on the other hand, bursal or lymphatic accumulations of fluid may be found outside a hernial sac, especially in the femoral region, when an ill-fitting truss has been long worn. There are vessels ramifying in the wall of the sac, but they are

not always distinct; and, misled by the appearance of vessels ramifying on a smooth surface, the bowel has been cut into, under the impression that its wall was the wall of the sac. When a plastic form of peritonitis has invaded the hernial sac, the smoothness of the lining membrane may be entirely lost.

The sac, when well exposed, has usually a distinct capsule-like outline, its walls are tense, and when they are thin, the blood-stained fluid contained therein, or the purple gut, may give to the structure a bluish aspect. In a thick-walled sac, this somewhat characteristic bluish tint may be entirely absent.

The sac is best identified by the fingers, rather than by the eyes. As the hernia is laid bare, the surgeon should from time to time pinch up the coverings yet left undivided between the finger and thumb, and estimate their thickness.

Even when adhesions exist, he will be able to find a spot where no such attachments have been formed, to feel the contents of the sac slipping from his grasp, and to appreciate the thickness of the tissue still covering the hernia. When, after repeated examination, he finds that this layer has been reduced to very slender limits he should open it. It may represent not only the sac, but the layer of tissue outside it; or it may represent an unduly thick sac reduced by dissection. Before actually incising the supposed sac, he may follow up its neck and note its connections with the surrounding parts; he may endeavour to insinuate a narrow director by the side of the neck of the sac, and thus ascertain the exact relations of the tissue in question with the interior or exterior of the abdomen. If this latter precaution be taken, it is scarcely possible to open the bowel in mistake for the sac.

The more frequent error, however, is to mistake a thin mobile bluish sac for the bowel, and to make attempts to reduce it.

Any attempt to demonstrate the sac by counting the supposed anatomical layers that are divided in exposing it is almost sure to be fallacious.

The identification of the sac is usually not difficult in the corpulent, when allowance has been made for the depth of the incision, since the sac tissue often stands out in distinct contrast

with the mass of loose and fatty tissue that surrounds it. Greater difficulties in the way of identification may exist in the emaciated, and in those who have long worn an ill-fitting or unduly tight truss. In congenital herniæ the sac wall may be expected to be very thin, and it is not unfrequently opened prematurely.

The sac, having been identified, is well exposed, and its neck is well cleared.

Before opening the sac, the operator pinches up a minute portion of the wall between his finger and thumb, in order to estimate its thickness and to demonstrate that it is clear from attachments to the contents of the sac. A like fold in the sac wall is then picked up by dissecting forceps and opened by means of a scalpel, the blade of which is held nearly flat. The operator pulls the little fold of sac away from the bowel as he makes the division. When once an opening is made, it is readily enlarged by means of a blunt-pointed bistoury, or blunt-pointed scissors. The sac should be cleanly opened, and not torn open. The operation up to this point should be carried out by careful incisions, and not by tearing.

The method of exposing a hernial sac by tearing the tissues asunder with the forefingers or with a pair of forceps and a director does not belong to operative surgery.

2. Division of the Stricture, and the Treatment of the Contents of the Sac.—When the contents of the hernia are adherent to the sac wall, some difficulty may attend the full display of the protruded parts. (*See* page 532.)

The exposed bowel is carefully examined and its treatment determined upon. The less it is handled the better. If it be in a condition suitable for reduction, the next step will be to divide the stricture. The neck of the sac is examined with the point of the left forefinger, and the density of the stricture and the best point for introducing the hernia knife is determined upon. The finger must be used gently. There must be no attempt made to dilate the stricture with the finger, or to force the finger through the constricted aperture. The part of the bowel that usually suffers most in strangulated hernia is the part directly embraced by the stricture, and this is the

part that will be crushed and bruised if persistent attempts be made to force the finger into the stricture.

The forefinger lies with the nail towards the bowel, and the most the surgeon does is to make clear a point at which the hernia knife can be inserted. The finger is the best director: the hernia knife is passed along it with the blade flat against the finger. The point of the knife at last reaches the pulp of the finger that is pressed against the stricture, while the nail lies against the bowel. The point of the knife is passed, still on the flat, past the finger and into the ring. It is then turned with its edge towards the stricture, and by a slight movement

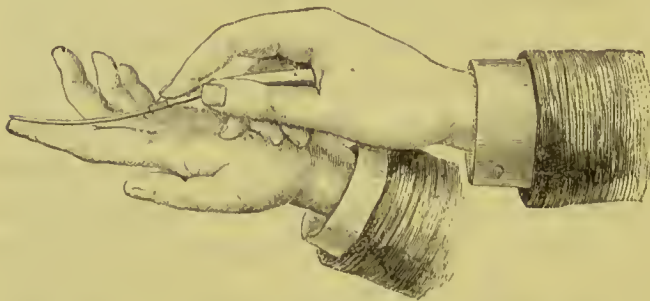


Fig. 421.—METHOD OF HOLDING THE HERNIA KNIFE.
(*Fergusson.*)

(The knife is represented too long in the blade.)

of the blade the stricture is divided. The position of the knife and the left forefinger during this manœuvre is shown in Fig. 421.

The left forefinger, or in case of a tight neck the little finger, acts throughout as a guide. It is retained in position after the knife has been withdrawn, and is then employed to ascertain that the division of the stricture has been sufficiently complete.

The knife is used with a gentle sawing movement; and with regard to the edge, it is better for it to be too blunt than too sharp.

In many instances the finger cannot be entirely relied upon, and a director must be used. This especially applies to cases where the neck is deeply placed, where the stricture is narrow and tight, and where a place for the introduction of the hernia knife cannot be made out by the forefinger.

The choice of the director employed must depend upon the habit of the operator and the nature of the case in hand. It is introduced with the right hand, guided by the left forefinger, and must be most carefully manipulated. The left

forefinger and the director are employed in exactly the same manner and relation as the forefinger and the knife.

When once the director has been passed through the stricture, and is in place, it is held in position with the left hand, while the hernia knife is used in the right.

The knife must be cautiously introduced. It is possible for the bowel to overlap the director and the knife, and to be cut by the movement of the blade. When the bowel is in danger, it should be pressed aside by the assistant with his finger or a small sponge held in a holder. It is well to have but a very limited cutting edge, and to see that the whole of the cutting edge is well within the stricture before the division is attempted.

After the knife has been withdrawn, the stricture may be further dilated with the director, which is forced against the divided fibres and therefore away from the bowel.

It should be a rule to endeavour to make as slight a division of the stricture as possible, such a division as will allow of the gut being reduced, and no more.

The loop of bowel should now be gently drawn down and the constricted part examined, since it is here that the injurious effects of the strangulation may be most manifest.

The next step is to reduce the gut, the fibrous and muscular structures around the hernial orifice being relaxed as far as possible. In inguinal and femoral ruptures this is effected by flexing the thigh upon the pelvis. An attempt is then made to squeeze the bowel by a kind of kneading movement with the thumb and fingers through the opening.

The manipulation must be of the gentlest, and the surgeon must be prepared to exercise considerable patience. If the coil will not return by pressure applied at one extremity, it may yield by pressure applied at the other end of the loop.

In some cases of difficulty, the reduction is rendered easier if the margin of the hernial orifice is held up by means of a small blunt hook introduced into it, or by two pressure forceps grasping the opened sac and straightening its neck. This especially applies to large inguinal herniæ.

In other cases more bowel may be drawn down from the abdomen, and the reduction may then be directed in the line

in which the withdrawal of the intestine appears to be the more easily effected.

Sometimes the reduction is simplified by returning the mesentery first and then the actual loop. In other cases it is desirable that the cut edges of the sac be held asunder with forceps, to prevent the walls from being folded in.

If the bowel be much distended, that part nearest to the ring can often be emptied of some portion of its contents by judicious manipulation.

Any flakes of lymph that may be disturbed in handling the gut should be washed away with warm sterile water.

After the reduction the finger should be passed through the ring into the abdomen, to make sure that all is clear. The sac is now washed out.

If any omentum exists in the hernia, it must be dealt with as its condition demands.

If it appears healthy, is small in amount, and is quite free from adhesions, it may be reduced. Nothing better can be done for it. In the majority of cases, however, it will need to be removed. It will be found to be altered in structure, to be inflamed, or to be matted into a granular kind of mass, or to be adherent.

Small portions may be ligatured *en masse* with one catgut ligature, and then cut off. Larger portions are most conveniently dealt with by passing a series of loops of catgut by means of an aneurysm needle, each loop enclosing one or more omental vessels. Fine catgut may be used, but each loop must be securely knotted, a treble knot being the safest. When the expanded portion of the omentum has been excised below the ligatures the latter should be inspected and cut short before returning the stump into the abdomen. The risk of a ligature slipping is avoided by making each include only a small part of the omental neck.

It is well to remember that, however large the protruded mass may be, it will have a comparatively slender neck.

The neck of the mass of omentum may be secured by a clamp, be excised close to the clamp, and be then treated by multiple ligatures. It is often possible to pick out the few

individual vessels that exist in the mass, and to ligature them separately. The use of the clamp is, however, not so safe as the method of under-threading above described.

The reduction of the stump of the omentum should be in every case complete. It should be returned quite free into the abdomen. No part should be left either in the sac or in its neck. All adhesions of the omentum to the neck of the sac must be cautiously and thoroughly divided, and the stump must be free. The employment of a stump of omentum as a plug to close the opening of a hernial sac is a procedure which has nothing to recommend it. Fixed omentum is a fruitful source of intestinal obstruction, and omentum attached to a hernial orifice tends to perpetuate a rupture at the spot.

3. Treatment of the Sac and the Closure of the Wound.

—In very severe cases, in which the patient is already much exhausted, and in which it is desirable to complete the operation with as little delay as possible, the sac may be left as it is, and the wound closed.

In cases of a less extreme degree, in which no complication exists that opposes the measure, the sac may be dealt with according to one of the methods of “radical cure.”

In the majority of cases the simpler the measure the better, and the methods described upon pages 558 and 567 will be found to answer the desired purpose of the operation.

The subjects of strangulated hernia are hardly in a condition suited to the performance of any elaborate or time-consuming operation; and for cases in which the rupture is exposed for the purpose of relieving strangulation, the more complex measures are ill-adapted.

The wound having been well washed out, and any redundant skin removed, the margins of the incision are united by sutures. In inserting the stitches, the edges of the cut should be kept upon the stretch by means of two small blunt hooks. (See page 66, vol. i.) The best suture material is silkworm gut.

In the simplest cases, where the sac has been closed, and in those in which the sac has not been opened, no drainage-tube is required.

In cases in which the parts have been exposed to much

manipulation, and in those instances especially in which the sac is left open and *in situ*, or in which the gut is left in a precarious condition, a drain should be employed. It may be removed at the end of twenty-four hours, or be retained longer, as circumstances direct.

Some dry dressing is applied, and is firmly fixed in position by means of suitable bandages. A pad of wool dusted with iodoform, or a pad of soft sterilised gauze, answers admirably.

After all hernia operations it is best to secure the dressings firmly by an elastic-webbing bandage outside the ordinary white linen or muslin one. A single length is applied in figure-of-eight and secured with a safety-pin. The amount of pressure required can thus be exactly obtained, the dressings cannot slip, and the strain in coughing or vomiting is taken off the wound.

4. **Treatment of Complications.**—A. *When the Intestine is Adherent to the Sac.*—Adhesions of the bowel to omentum are readily enough dealt with. The omentum, if it cannot be peeled off from the intestine, is cut away with scissors until only the slightest trace of it is left still attached to the gut, which can then be reduced.

Adhesions of the bowel to the sac may, when slight and recent, be broken down with the finger or a flat director; when, however, they are of old standing and extensive, their treatment becomes a matter of some difficulty. These examples of extensive and firm adhesions are for the most part met with in old umbilical or scrotal herniæ of large size, which have been for many years irreducible, and have perhaps been more than once inflamed.

The “breaking-down” of such adhesions must be a matter of infinite care, as the bowel is, as a rule, more readily torn than is the wall of the sac.

Many of the adhesions can be divided with scissors or a scalpel, and some may be torn through after partial division. In the case of a very large and neglected labial hernia, which had been many years irreducible and had become strangulated, I found that a loop of colon contained in the sac had become firmly adherent to the coverings of the hernia, which were so

very greatly thinned that the gut was practically attached to the skin.

As separation would have been dangerous, I divided the skin all round the attached area. I then reduced it to the smallest possible dimensions by trimming with the scissors, scrubbed it, scraped off its epithelial surface to ensure its being clean, and returned the bowel into the abdomen with the disc of skin still adherent to it.

In another case I returned a loop of bowel with a considerable portion of the sac still adhering to it—it having been found to be easier to separate the sac from the tissues outside it than to detach it from the bowel. The adherent tissue was reduced to the smallest possible dimensions by dissection before the gut was replaced.

In any case in which long-adherent gut is reduced, it must be remembered that it is reduced with a raw surface, and that it will probably acquire a fresh attachment within the abdomen.

No loop of intestine should be returned the limbs of which are united by adhesions; and the same observation applies to reducible bowel which is adherent to reducible omentum.

“A few cases remain,” writes Mr. Jacobson, “in which adhesions should be left alone. When gangrene is threatening, their presence, especially about the neck of the sac, is the chief safeguard against extravasation into the peritoneal cavity. In some cases of large hernia, if the patient is much collapsed, as long as any recently-distended loop is returned, any long-adherent intestine may be left. And in other cases of collapse from delay of the operation, where there is much difficulty in returning a loop of intestine, especially if this is not in good condition, it may be left after the stricture has been sufficiently divided.”

B. *When the Gut is Gangrenous.*—Much has been written upon the subject of the treatment of gangrenous intestine in hernia, and very remarkable differences of opinion have been expressed upon the question. It would be out of place to enter into a discussion of this subject, or to consider minutely the physical signs that may distinguish intestine which is gangrenous from that which may still recover.

If the bowel, when exposed, be in what may be termed a doubtful condition, it had better be reduced into the abdomen. It is in a more favourable position for recovery within the peritoneal cavity than within the inflamed sac. Before replacement, the parts concerned should be well washed with an antiseptic solution. Such a coil of bowel seldom travels far from the hernial ring. The sac should be left open, and a drainage-tube of large size be introduced. If the gut at a later period gives way, it will do so gradually; and as adhesions are rapidly formed, the intestinal contents will escape along the course of the open sac. Whatever theoretical objections may exist to this procedure, practice has shown that it may be safely carried out, assuming that it applies to bowel which is not actually gangrenous, but in a condition which may be termed doubtful. It is remarkable to what an extent these loops of "doubtful" intestine recover.

If the bowel, when exposed, be found to be gangrenous, two courses are open to the operator:—

(1) The stricture may be divided, and the gangrenous bowel resected.

In carrying out the resection, either an artificial anus may be established, which can be closed by a subsequent operation, or the divided ends of the gut may be at once united and returned into the abdomen. The union may be effected by means of a double row of sutures, or by Murphy's button; by preference the former if the patient be in a condition to bear the lengthy operation. For discussion and description *see* page 304 *et seqq.*

(2) The sac having been well opened up and well washed out with an antiseptic solution, the bowel is left *in situ* after having been incised. The parts are well dusted with iodoform, and means are taken to provide the most efficient drainage. Several surgeons of eminence advise that in these cases the stricture should be divided, and that the gut should be left *in situ*, having been first secured by means of two or three silk stitches passed through the serous and muscular coats, and then fastened to the skin. The objection to this plan is that the abdominal cavity is opened up and exposed to infection

from the putrid contents of the sac. A barrier of lymph will have already shut off the gangrenous segment, and this protective barrier is broken down. Should the bowel be in a doubtful condition, the plan last described may be advisable; but when it is actually gangrenous, it does not appear to have much to recommend it. It has been urged, also, that if the stricture be not divided, the intestinal obstruction is not relieved. This argument in favour of dividing the stricture is, however, not supported by experience. It will be found that when gangrene has set in, nearly all tension is taken off from the parts, especially when the gas and œdematous effusion which attend the process are evacuated by an incision; and it is usual to observe faecal matter at once escape when the putrid bowel is incised.

If there be no immediate escape of the intestinal contents, such discharge will take place as soon as the swelling of the parts has subsided, as a result of the incision of the gut.

As to which method is the better, the resection of the bowel or the leaving of the dead loop *in situ*, the decision must depend upon the precise circumstances of the case. A patient with so advanced and severe a form of strangulated hernia that the bowel has become gangrenous, will hardly be in a condition to undergo a tedious and elaborate plastic operation. At the same time, conservative treatment of the gangrenous gut is very rarely followed by recovery. The subject, especially with regard to the safest method of performing enterectomy, is discussed in a paper by one of us (J. H.) in the *Clin. Soc. Trans.*, 1900, p. 71. In that paper details of 40 cases were given. In 11 of these the gut was left *in situ* or an artificial anus made. Every one of them died. In 14, resection was carried out by means of Murphy's button; only one case recovered. In 15 cases circular enteroraphy after resection was performed; 7 patients recovered. It is thus plain that in dealing with gangrenous gut, resection with careful suturing offers the best chance, and that from 40 to 50 per cent. of the cases may recover. It is important that the resection should be carried out through healthy intestine—*i.e.* wide of the

gangrenous area, and it is better to remove too much than too little.

c. *When the Intestine is Wounded.*—The bowel may be accidentally wounded when too rash a division of the superficial parts is made, when adhesions exist between the gut and the sac, when the altered gut is mistaken for the sac, or when

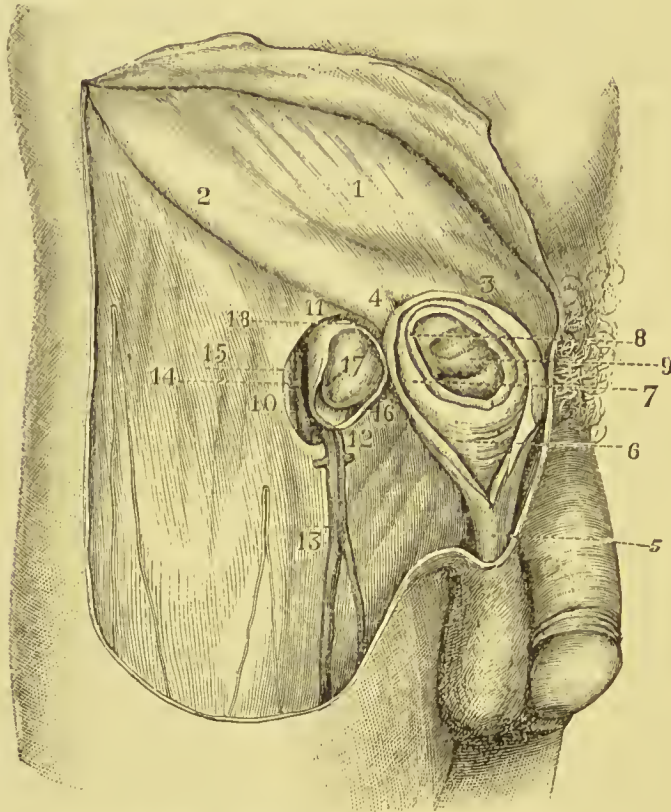


Fig. 422.—INGUINAL AND FEMORAL HERNIA.

- 1, External oblique muscle; 2, Poupart's ligament; 3, Inner pillar of outer abdominal ring; 4, Outer pillar of the same; 5, Spermatic cord; 6 and 7, Coverings of the sac; 8, Sac; 9, Intestine; 10, Falciform process; 11 and 12, Boundaries of saphenous opening; 13, Saphenous vein; 14, Femoral vein; 15, Femoral artery; 16, Sac; 17, Intestine; 18, Abnormal obturator artery. (Rüdinger.)

the loop of bowel comes into accidental contact with the edge of the hernia knife as it is being passed through the stricture.

The opening made should in each case be closed by means of Lembert's suture, the loop of gut should be returned into the abdomen, and if the wound has been extensive, it will be as well to leave the sac open, and to introduce a large drainage-tube, in case the intestine should give way at a later period.

THE OPERATION AS APPLIED TO PARTICULAR HERNIÆ.

1. **Inguinal Hernia.**—The anatomy of the hernia is shown in Fig. 422. The patient having been prepared in the manner already described, an incision is made over the centre of the tumour, and in the long axis of the tumour, and is so arranged that the centre of the wound will about correspond to the external ring (Fig. 423). It is rarely necessary to encroach upon the scrotum, and the incision need not come below the pubis; it will then be easy to keep the wound aseptic and protected by the dressing.

The cut may at first be some inch and a half in length, and may be enlarged subsequently if required.

The sac is exposed; the only layers of tissue which will probably be recognised are the

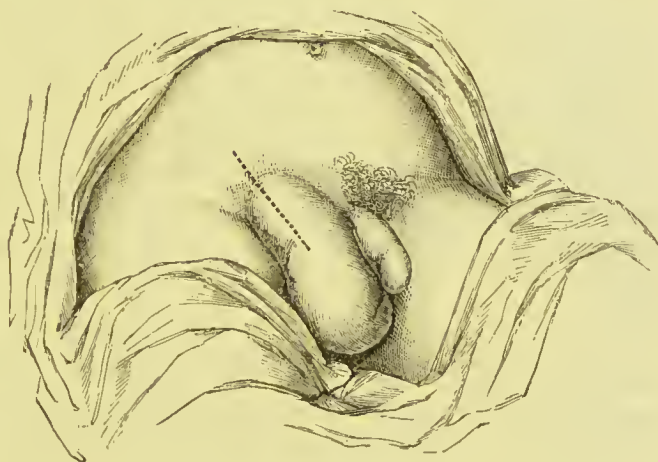


Fig. 423.—INCISION FOR INGUINAL HERNIA.

intercolumnar and the cremasteric. The superficial external pudic artery will probably be severed in dividing the subcutaneous tissues.

The sac is opened and the contents are dealt with in the manner already described (page 529). In dividing the stricture, the knife should be made to cut in a direction upwards, *i.e.* parallel with the median line.

To relax the parts about the inguinal ring as the bowel is being reduced, the thigh should be a little flexed upon the abdomen, and should be at the same time a little adducted and rotated in.

In the case of a large scrotal hernia, any redundant skin may be excised.

After the wound has been closed, the dressing is applied, and is fixed in place by means of a spica bandage, which should be applied while the thigh is in the position of flexion.

When the limb is brought again into the extended posture the bandage is drawn tight.

Comment.—There is nothing to commend the practice of dividing the skin by picking up a fold of integument and transfixing it, nor in exposing the sac is it wise that the overlying tissues should be “torn through with the nails of the forefinger.”

The various anatomical forms of inguinal hernia must be borne in mind. In the congenital varieties the sac has nearly always a long neck, which corresponds to the length of the inguinal canal. The internal and external abdominal rings are separated by a normal distance, and the canal has a distinct existence. In these herniæ strangulation is often acute and urgent, and the protrusion has to be followed up to the end of the inguinal canal before the stricture can be properly dealt with.

In an acquired hernia of long standing, on the other hand, the two abdominal rings may become approximated. The inguinal canal can scarcely be said to exist, and when the rupture is reduced, the breach in the abdominal wall presents the features of a more or less simple hole. In such cases the neck of the sac is short and easily reached, since it is practically within the grip of the external ring. The acquired hernia is, other things being equal, more easily treated by operation than the congenital form, and the thinness of the sac in the latter variety adds to the difficulties of manipulation.

In a form of what is known as the encysted hernia, more than one layer of peritoneum may be met with in exposing the gut.

In inguinal hernia the stricture is very often situated in the neck of the sac itself, and in such cases no reduction can be effected until the sac has been opened up.

The exact site of the stricture, and the precise anatomical structure which produces it, are matters of little practical moment. The operator will soon identify the stricture, ascer-

tain its position and density, and decide upon the best means of dividing it.

In dividing the stricture, the only vessel in danger of being damaged is the deep epigastric; and if the incision be kept within proper limits, this danger is very slight. In the oblique form of rupture, an incision directly upwards would quite avoid the artery; but in a direct hernia, where there is reason to suppose that the vessel is in close connection with the neck of the sac, it is well that the incision be directed a little inwards as well as upwards.

2. Femoral Hernia.—

The anatomy of the hernia is shown in Fig. 422. The usual preparations having been made, a vertical incision is made along the inner side of the tumour, and is so placed that the centre of the cut will about correspond with the upper border of the



Fig. 424.—INCISION FOR FEMORAL HERNIA.

saphenous opening (Fig. 424). The wound will be at first about one inch and a half in length, and may be enlarged as required. The incision indicated in Fig. 424 is both too short and placed more internally than is often advisable. The exact position and extent of the wound must depend on the individual case, but the further from the vulva it is placed the more easily will asepsis be obtained.

As a rule, no vessels of any note are divided in exposing the sac.

The operation is completed in the manner already described (page 531).

The stricture is usually formed by the margin of Gimbernat's ligament, and should be divided by cutting upwards and inwards, *i.e.* towards the median line.

In reducing the bowel the thigh should be a little flexed, adducted, and rotated in.

A similar spica is applied to that used in inguinal hernia.

Comment.—The operator may be reminded that the femoral vein lies to the outer side of the femoral ring, that the spermatic cord (in the male) lies just above its anterior border, and that the epigastric artery skirts its upper and outer part. The little pubic branch of this artery passes round the ring to ramify over Gimbernat's ligament. In one case out of three and a half the obturator artery arises from the epigastric. Out of 101 cases where the vessel so arose, it reached its destination in fifty-four instances by passing along the outer side of the crural ring, a position quite free from danger in herniotomy. In thirty-seven cases it passed backwards across the ring, and in ten instances around its inner border (R. Quain) (Fig. 422, 18). The chance of meeting with this abnormal obturator artery in the dangerous position to the inner side of the neck of the sac is only about one in forty. Even then the risk of wounding it with the herniotome is slight if the following precaution be observed. Gimbernat's ligament should be notched slightly at two points rather than cut deeply in one; the finger is then insinuated beyond the ligament so as to ascertain whether the abnormal artery is present or not. In spite of the rarity of its abnormal course, this artery has been wounded in several cases during herniotomy, some of them fatal. The accident may not be noticed at first owing to the hæmorrhage occurring within the abdomen.

The bleeding may best be dealt with by enlarging the wound and ligaturing the bleeding point, or by making a special incision parallel to Poupart's ligament and exposing the vessel through it. The hæmorrhage has also been checked by the application of pressure, and in a less satisfactory manner by means of acupressure.

The subject of the wound of this artery has been fully dealt with by Mr. Barker in a paper in the *Transactions of the Clinical Society* (vol. xi., page 180).

After-treatment of cases of Herniæ of the Groin submitted to

Operation.—The patient should observe the recumbent position, and must avoid all exertion and straining during the period of convalescence. He should not be allowed to lift himself in bed. It often happens that the comfort of the patient may be increased by allowing the thighs to be kept a little flexed, by introducing a pillow beneath the knees. In male patients retention of urine is occasionally complained of.

The dieting of the patient should be upon the lines observed in the after-treatment of cases of Abdominal Section (page 244). Opium should not be administered unless distinctly indicated. The bowels should be opened on the fourth day by an enema, unless previously relieved. Flatulent distension of the belly may be relieved by the use of the rectal tube, or, if severe and persistent, by means of a saline aperient. In some rare cases a severe diarrhoea sets in within a day or so of the operation, and is not only very difficult to cope with, but may soon lead to death from exhaustion.

The drainage-tube should be removed within forty-eight hours in ordinary cases that are doing well. The sutures may be taken out on the eighth day, or later. The wound should be dressed whenever the bandage becomes loose, and the parts around must be frequently washed and kept scrupulously clean.

The patient should not be allowed to get up until three weeks have elapsed after the operation, and then only if the wound is sound.

The question of a supporting bandage or a truss will then have to be considered. If the surgeon has been able to perform a radical cure at the time of the herniotomy no truss need be worn, otherwise a light truss will be required. In the case of a large femoral hernia it is difficult to prevent recurrence, and hence a truss is usually advisable.

3. Umbilical Hernia.—To appreciate properly the operation carried out for the relief of strangulated umbilical hernia, it is desirable to draw attention to the three forms of rupture met with in this situation.

(1) *Infantile Hernia.*—This, the common hernia in infants, appears some time after the separation of the umbilical

cord, and is due to a yielding of the umbilical cicatrix. The rupture is generally small and simple. It exhibits a decided tendency towards spontaneous cure, is very efficiently treated

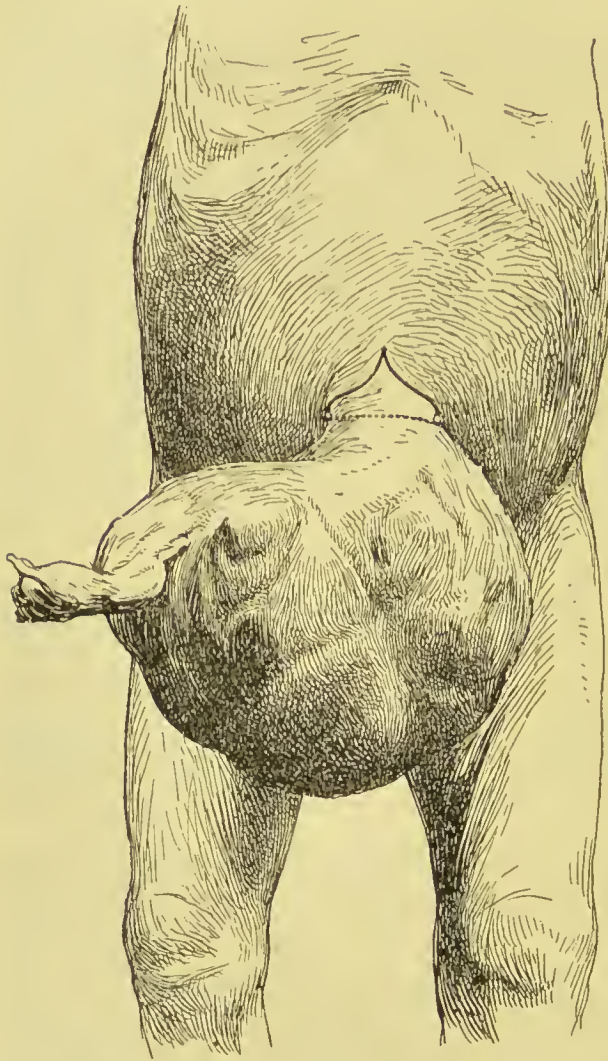


Fig. 425.—CONGENITAL UMBILICAL HERNIA CONTAINING MUCH INTESTINE IN A THIN SAC.

The umbilical cord is shown, and the line of incision for radical cure.

by means of strapping so applied as to approximate the margins of the opening in the abdomen, and appears to have demanded operative interference of any kind very seldom indeed.

(2) *The Congenital Form* is observed at birth, and depends upon a defect in the anterior abdominal parietes. The hernia, which commonly contains the cæcum, is forced between the structures of the cord, and with those structures the sac is more or less imperfectly covered. These herniæ, when dealt with by operation, need to be treated by means of

the method of radical cure described below. The gut is reduced, the sac is cut away, the edges of the opening in the abdominal wall are freshened, and the gap is closed by many deep sutures. Over these the skin is united by superficial sutures. I have operated upon several such herniæ in the manner described. These ruptures may become strangulated,

and I have reported a case in which I operated upon a rupture thus affected in an infant sixty hours old (*Lancet*, February 20, 1881).

In a case of congenital umbilical hernia such as is represented in Fig. 425, radical operation affords the only chance of saving the infant, and it should be performed without delay. The whole of the thin sac is removed, the incision being made through healthy skin round the umbilical orifice. The umbilical vessels will probably require separate ligature. Every care should be taken to diminish the shock by rapid operation, a warm temperature, and the avoidance of hæmorrhage. No difficulty is usually met with in returning the coils of intestine within the abdomen provided that they have not already become inflamed and adherent.

(3) *The Hernia of Adults*.—This rupture may be quite small, and may contain but a single knuckle of bowel. When it becomes strangulated, the symptoms are apt to be acute, and to call for immediate treatment. The strangulation will usually be found to be at the lower part of the neck of the sac, *i.e.* to be brought about by the lower margin of the rigid hernial orifice.

In such case it may suffice to displace the hernia upwards, to make a vertical incision over the lower part of the tumour, to expose the sac, to open it or not as occasion suggests, and to divide the stricture by cutting from above (*i.e.* from the hernia) directly downwards. These ruptures are, however, exceptional, and the great majority of the umbilical herniæ that come under the surgeon's notice belong to the next category.

The hernia is large, and possibly of enormous size; the patients are most frequently women past middle life. They are usually corpulent, and often excessively so; their tissues are flabby; their muscular development is feeble; their digestive organs are deranged; and they are not unfrequently the subjects of embarrassed breathing. They make bad subjects for operation, and the unwieldy character of the huge and pendulous abdomen, which is shaken terribly by every cough, adds a difficulty to the after-treatment. The contents of these herniæ are usually in whole or in part irreducible. They

generally contain omentum as well as bowel, and often present a loop of the transverse colon. Adhesions of an extensive and complex character may be anticipated, and the symptoms of strangulation are generally of a subacute character. The symptoms, indeed, are more allied to those that are associated with the so-called incarcerated or obstructed herniæ than with distinct strangulation. The coverings of the hernia are usually thinned, unhealthy, and discoloured; the mass is pendulous, and its general outline is lobulated.

If these herniæ are dealt with by operation, I think that it is most desirable, whenever possible, that the "radical cure" should be carried out. To reduce the bowel, and leave the enormous sac behind, is to place an obstacle in the way of safe healing, and to perpetuate the trouble.

My results in dealing with these herniæ—which are not uncommon among the Jewish patients who apply at the London Hospital—have been infinitely better since I have in every instance not only reduced the protrusion but carried out the operation for radical cure which is here described.

The Operation.—In addition to the instruments already enumerated, the surgeon should be provided with ivory spatulæ, curved needles in handles, and large curved Hagedorn's needles.

The patient is prepared as for an abdominal section, and the general disposition of those concerned in the operation should be the same as is observed in that procedure. The surgeon will always stand to the patient's right.

The parts must be well cleansed, and, among the poorer class of patients, the need for such a preliminary is often unpleasantly evident.

After the whole hernial region has been well rubbed with soap and water, the skin should be repeatedly cleansed with an alcoholic solution of carbolic acid (1 in 20), or a similar solution of biniodide of mercury (1 in 500).

Nearly the whole of the skin involved in the protrusion is now marked off by means of an elliptical incision, the long axis of which will correspond to the median line. The incision will extend, indeed, on to the median line above and below the swelling; and as it crosses the tumour it will traverse its

wall on either side, but a little way from its base. The incision is such as would be made to remove a pendulous tumour of like dimensions situated in the midst of comparatively lax tissues.

The first incision is only skin deep, and the hernia must be moved from one side to the other with the left hand as occasion requires.

The surgeon now deepens the wound upon one side of the base of the mass, and, by cutting through the subcutaneous tissue, aims at exposing the aponeurosis of the abdomen a little way beyond, *i.e.* to one side of the neck of the rupture. To effect this, such skin as covers the base of the protrusion is turned back. When once the aponeurosis is reached, it is followed all round the stalk of the tumour by deepening the incision. When this has been done, the hernia, covered by perfectly undisturbed skin, will be entirely isolated from all the tissues outside the abdomen, and will be attached only by its neck. The neck must be well cleared, and the aponeurosis which bounds it, and which, therefore, forms the margin of the hernial orifice, must be laid quite bare.

The sac may now be opened at any convenient spot where it can be proved to be free from adhesion to its contents. The contents are exposed, and are dealt with in the manner already described. Adhesions are divided, the bowel is freed, and, if in sound condition, is reduced into the abdomen. Before this can be done, the hernial orifice will need to be divided; and this can be effected by enlarging the opening above and below the neck of the sac in the median line with a probe-pointed bistoury. This division may be extraperitoneal. After the gut has been replaced, the omentum is excised, or is dealt with in a manner suited to its condition (page 530).

The omentum is best ligatured and cut through where it emerges from the abdomen, without regard to its adhesions to the sac. By this method considerable time is saved in the operation.

The sac is at last emptied, and the hole leading into the abdomen is then plugged with a large Turkey sponge secured in a holder.

The next step is to excise the whole of the sac and its coverings, including the elliptical portion of the skin, down to the level of the aponeurosis. This may be effected with the scalpel at one sweep.

The margins of the ring are now freshened, as in plastic operations involving the skin, and the opening in the aponeurotic part of the abdominal parietes is closed by sutures. These buried sutures should be of silk or of strong kangaroo tendon. They may be introduced on a curved needle in a needle holder. Before they are inserted, the sponge should be removed and be replaced by the end of an ivory spatula, which will serve to protect the intestines from injury. As many sutures as possible should be introduced before any are tied. They must be closely placed—four to six to the inch—and must include the whole thickness of the aponeurosis and the peritoneum.

The operation is concluded by suturing the skin and subcutaneous tissues with silkworm gut. The wound is entirely closed, and no drainage-tube is required. The dressing of the wound and its subsequent treatment are conducted upon the lines observed in other abdominal operations.

It is well that the patient should wear a supporting belt for some months; but in the majority of the cases this can be in course of time dispensed with.

4. Obturator Hernia.—In this form the gut escapes through the obturator canal, between the horizontal ramus of the os pubis and the uppermost fibres of the obturator externus muscle. The obturator vessels may be found either on the outer or inner side of the sac, or above or behind it. Among the cases collected by Dr. Charles Firth (*Brit. Med. Journ.*, April 19, 1890) the vessels were to the inner side in six cases, to the outer side in six cases, and behind the sac in three cases. The proximity of the nerve renders it very liable to be pressed upon, and pain along the nerve is often a marked symptom of the rupture.

The hernia presents beneath the pectineus muscle, to the inner side of the capsule of the hip, behind and to the inner side of the femoral vessels, and to the outer side of the adductor

longus tendon. This hernia is more common in females, and it is worthy of note that the obturator canal can be examined to some extent through the vagina.

The *operation* for exposing the hernia *in situ*, when strangulated, is carried out as follows :—

The parts having been duly cleansed, a vertical incision, from three to four inches in length, is made over the tumour, midway between the line of the femoral artery and the spine of the pubes. The subcutaneous tissues and fascia lata having been divided, the upper edge of the adductor longus muscle is reached. The deep external pudic artery would probably be severed. The upper border of the long adductor is pulled downwards and inwards with a wound retractor.

The fibres of the pectineus muscle are either separated by using the handle of the scalpel, or are divided transversely.

The obturator muscle is next defined, and the sac exposed by a little careful dissection. The hernia may protrude above that muscle or through its uppermost fibres.

The thyroid membrane is then nicked in a downward direction, and the gut reduced. The sac may or may not be opened. Care must be taken not to wound the femoral or saphenous veins. In dividing the constriction, a lateral incision should be avoided. The sac may be dissected out, and its neck ligatured, as was done in Dr. Firth's case. Before the wound is closed, a drainage-tube should be inserted.

Dr. Firth states (*loc. cit.*) that out of twenty-five cases recognised during life, seventeen were subjected to operation, eight were relieved by taxis, but only five altogether were saved by the two methods of treatment.

The bowel may be reduced through an incision made in the median line of the abdomen, traction being made upon the gut while pressure is brought to bear upon the tumour in the thigh. This method would appear to possess distinct advantages if carried out in suitable cases and at an early period. The operation has been performed by Mr. Hilton and by Mr. Godlee. In both cases, however, death resulted.

5. **Other forms of Hernia.**—It is unnecessary to allude

to other forms of hernia which, although exceedingly rare, may be, or have been, treated by operation.

It may suffice if reference be made to recent papers dealing with these herniæ.

Lumbar Hernia.—Mr. Macready (*Lancet*, November 8, 1890) has collected twenty-five examples of this hernia. In six, strangulation occurred; of these, two were operated upon: one recovered and one died. One case appeared to have been untreated, and the remaining three were successfully dealt with by taxis.

Sciatic Hernia.—M. Wassilieff (*Revue de Chirurgie*, March, 1891) describes a case in which strangulation occurred. The rupture was successfully reduced. He enters fully into the anatomical relations of this uncommon hernia, and the operation which should be carried out, should such treatment be demanded.

Perineal Hernia.—M. Winckel (*Annales de Gynécologie*, August, 1890) deals very fully with the subject of this hernia, with its varieties and anatomical relations. He advises the treatment of this form of rupture by a radical operation.

Intraparietal and Prevesical Hernia.—Two papers on these exceptional forms of hernia, with references to the literature of the subject, are given in the *Med.-Chir. Soc. Trans.*, 1899, page 305, by Messrs. G. H. Makins and J. Hutchinson, Jnr. Each writer records a successful operation for prevesical hernia.

CHAPTER II.

OPERATIONS FOR THE RADICAL CURE OF HERNIA.

FROM the earliest days of medicine surgeons have concerned themselves with attempts to cure hernia by means of operation. The methods either advised or actually employed are legion, and no chapter in the literature of surgery contains more remarkable measures, or more extravagant and varied efforts of invention.

Chelius, in his "System of Surgery," has given a very interesting history of this strange development of surgical practice, and has endeavoured to classify the innumerable operations which the restless activity of one generation after another has brought before the medical world.

The majority of the methods of treatment are no longer of any but historical interest.

The treatment by increasing pressure, which was maintained by means of a conical linen pad until the skin ulcerated, has been obviously abandoned. The same is to be said of the terrible and barbarous methods by caustics and the actual cautery.

The method of "healing-in" a detached portion of skin, or of a portion of infolded skin, into the abdominal ring, was very extensively practised. One of the last of these operations, that designed by Wützer, was attended by a slight success, and the account of the method has but recently disappeared from surgical text-books.

The treatment by injection is of old date. The fluid originally employed was red wine. Injection methods have been revived of late years, and have been advocated by several surgeons. They are, however, both dangerous and useless, and should never be employed.

The treatment by ligature of the sac is of some antiquity, and, in view of the operations now carried out, the early modes of effecting this object are of interest.

Berard laid bare the hernial sac by an incision, and surrounded the neck of the sac and the spermatic cord with a golden thread. This was drawn sufficiently tight to close the ring, but not to compress the cord. This was the method by "the golden puncture."

Paré separated the hernial sac from the surrounding parts, and after tying it with a leaden thread closed it with the glover's suture. This was the method by "the royal stitch."

Sir Astley Cooper dissected out the entire sac in a case of femoral hernia, and "passed stitches through its mouth so as to bring the edge into perfect contact." The wound healed, but the hernia returned. Petit carried out the same operation. Neither surgeon formed a favourable view of the measure, and it was condemned by Lawrence and others of his time.

Within recent years the development of the operation for the radical cure of hernia is closely associated with the name of Professor Wood, of King's College. He adopted a method of closing the hernial aperture by means of a wire suture passed subcutaneously. The procedures devised by Mr. Wood were ingenious although complicated, and represented for some years the best known means of attempting to cure ruptures by operation.

Wood's operation, and such like measures as are founded upon the principles underlying his operation, were never very extensively adopted, and it may be said that they have now given place to simpler and surer modes of treatment.

With the advent of antiseptic surgery and of improved methods of treating wounds, there soon arose a series of operative measures from which those procedures which are now in extensive use have been rapidly developed. The work of Lord Lister rendered these operations possible, and conspicuous among the pioneers of the modern operation is Sir Mitchell Banks, to whom is largely due the credit of demonstrating the possibility of what may be termed the open method of operating.

Within the last twenty years the "radical cure" of hernia has been developed with remarkable rapidity and vigour, and the operations which are included under that name are now among the most successful in surgery.

It is acknowledged that the term "radical cure" is possibly a little too ambitious, and it has had to be pointed out by every operator that the methods employed are not infallible. Still, every year that passes gives to these measures a better claim to a title with which they have been associated from their beginning.

Without entering into the circumstances in which these operations are performed, it is only necessary to point out that they are restricted to certain selected cases, and are not adapted for indiscriminate employment.

It would be out of place to attempt even to enumerate the very many operations that have been described under the title of radical cures for hernia.

A large number are insignificant modifications of previous and more or less well-known operations. It is probable that few operating surgeons adhere precisely to any one method, nor is it

to be expected that they should carry out this operation at all times upon the exact lines laid down by the originator. The principles underlying the various methods employed remain unchanged, while the actual *modus operandi* must of necessity be modified by the particular surgical habits of each operator.

I.—THE RADICAL CURE OF INGUINAL HERNIA.

Preliminary Considerations as to the Methods Employed.

—It is generally admitted that the most important step of this operation is the obliteration of the peritoneal sac at the level of the internal ring—*i.e.* where the deep epigastric vessels pass round it. In a considerable number of cases, especially in children and young adults, where the inguinal canal is otherwise normal, this high ligature and excision of the sac will suffice to obtain a radical cure. In others where the canal has been stretched and the two rings perhaps approximated, it is advisable that in addition the canal should be narrowed by means of deep or buried sutures. Such narrowing, however, should not be effected at the external ring, but higher up, where a hernia first begins to protrude.

To Bassini we owe the demonstration that if the external oblique aponeurosis be slit up over the canal, it is easy for the surgeon to deal with the sac at its highest point, and to effect a narrowing of the canal by sutures which can be placed with far more accuracy and safety than if the parts are not exposed. Further, the surgeon is able, if he prefers this method, to transplant the cord forwards and completely obliterate the former inguinal canal. For these reasons some modification of Bassini's method is used by the great majority of surgeons with much experience of the radical cure. At the same time, to slit up the inguinal canal and to place a number of buried sutures deep in the abdominal wall is attended with obvious risk if suppuration should occur. If silk be employed for this purpose, it is apt to give trouble and to work out, leaving the wall of the canal weaker than it was before the operation. The thicker the silk used the greater is this risk. Kangaroo tendon, if properly prepared (it is easy to sterilise), never gives trouble, and

becomes incorporated with the fibrous tissues of the part. In an experience of several hundred cases in which it has been employed for deep sutures I (J. H.) have found it perfectly safe and efficient.

Messrs. Bull and Coley, from a long experience of its use in radical cure of hernia, speak strongly of its superiority to silk. Mr. John Wood in his later operations (*i.e.* about 1880-1885) employed kangaroo tendon to a large extent to replace the use of silver wire, which latter had to be removed some time after the operation.

During the last few years kangaroo tendon and silver wire have been re-discovered in America, and some surgeons there have gone to the extreme of burying quantities of silver wire not only in the muscles and aponeuroses attached to Poupart's ligament, but also in the subcutaneous tissues over it. A more unsuitable place than the fold of the groin for rigid wire knots it would be difficult to conceive. The large proportion of serious complications given in Bloodgood and Halsted's record (*Johns Hopkins Reports*, vol. vii., 1900) should deter any surgeon from following the method described. Thrombosis of the femoral vein, orchitis, and atrophy of the testicle were not unfrequently met with after radical cures of hernia which involved free division of the internal oblique, transplantation of the cord, excision of spermatic veins, and, above all, the insertion of many loops of silver wire into the deeper layers of the abdominal wall.

It is possible to secure a tough inguinal scar at too high a price if it involves thrombosis of the femoral vein and persistent œdema of the leg. Moreover, the formation of a tough scar is in no way essential to the permanence of a radical cure. In the most perfect cases the scar is hardly perceptible to the eye or finger, and hence primary union of the whole of the wound should invariably be aimed at. Methods in which the wound is encouraged to granulate up in order that a large scar shall prevent recurrence are now completely discredited. There are no cases so difficult to operate upon as those in which a previous attempt at radical cure has been followed by suppuration; and it may be noted that in a

considerable proportion of recurrent herniæ this complication has attended the original operation. Not only will the surgeon find recurrent herniæ especially difficult to operate on, but the prognosis becomes much more serious.

This is illustrated by the report of eleven such cases operated on at St. Thomas's Hospital in 1896. All the patients were under fifty years of age, and most of them were young men. In three cases slight suppuration was said to have occurred after the original operation, but after the second it followed in no less than seven. Two of these patients died of septic peritonitis. It is possible that the use of silk or gold-beater's skin for the deep ligatures was in part responsible; and in one a ligature had been placed on the omental stump close to the colon ("which was possibly wounded"). Still, a proportion of suppuration in 70 per cent. and death in 20 per cent. after simple radical cure of inguinal hernia is unheard of in cases of primary operation.

It is thus obvious that rapid and sound healing of the wound is essential, and where the conditions are such that this is problematical the surgeon may well hesitate to operate.

Selection of Cases for Radical Cure. — In children with inguinal hernia of moderate size and easily kept up by use of a truss, operation may often be dispensed with, and it should at any rate be deferred until an age is reached at which the patient has control over the bladder, so that the risk of soiling the dressings will be avoided.

In elderly subjects chronic bronchitis is the chief contra-indication to operation, since the lung-symptoms will be increased by the anæsthetic, and may have a serious effect upon the healing of the wound. Very stout patients, and, still more, those with flabby pendulous abdominal walls, are unfavourable subjects.

Although the size of the hernia is no absolute criterion, a large irreducible one which has for long lodged much of the intestine is not favourable for radical cure; still, even under these conditions the attempt may be justified by the result. In the case of a double inguinal hernia of reasonable size, both sides may well be operated on at the same time. The

presence of several incomplete herniæ or weak spots in the abdominal wall should, however, be regarded as negating the idea of operation.

Instruments Required.—Blunt hooks ; scissors ; scalpels ; pressure forceps ; dissecting and fine pointed forceps ; curved and straight needles ; needle-holders, etc. Special mounted needles (of the pattern designed by Sir W. MacEwen and others) are sometimes used, but they are usually made too clumsy and blunt at the points. A simple long needle mounted on a holder and sharp-pointed is useful. It should be slightly curved on the flat. For introducing the deep stitches, ordinary fully-curved needles will be found more convenient than any special form. It is most important that all sutures, whether they are to be buried or not, should have been rendered perfectly aseptic. For the deep sutures there is nothing to equal kangaroo tendon which has been preserved in 1 in 20 alcoholic solution of carbolic acid, and which before the operation is placed in cold sterile water to remove the antiseptic agent.

The Incision, etc.—The whole of the pubic region having been shaved and carefully disinfected beforehand, the skin over the inguinal canal is finally cleansed with an alcoholic solution of carbolic acid or biniodide of mercury, and then dried with sterilised pads. The penis and scrotum, thighs, and upper part of abdomen are protected by dry sterilised towels. Only the region just above Poupart's ligament requires to be exposed, as the incision is placed here whether the hernia may have descended to the bottom of the scrotum or not.

The operator feels for the pubic spine, identifies the external ring and Poupart's ligament, and then proceeds to make a linear incision which commences over the ring and runs for three or four inches parallel to and above the ligament (Fig. 426).

This incision goes straight down to the external oblique aponeurosis, which is the first landmark recognised ; when it is exposed, the handle of the scalpel should be used to clear both the external ring and the aponeurosis upwards and downwards. In making this incision the superficial epigastric vessels

and perhaps the superficial external pubic ones are divided, and should be at once secured with pressure forceps. These forceps should be held up by the assistant, as they serve as excellent retractors. Towards the end of the operation these small arteries and veins may be tied with catgut. In the great majority of cases the surgeon will incise the external oblique from one inguinal ring to the other, but whether this

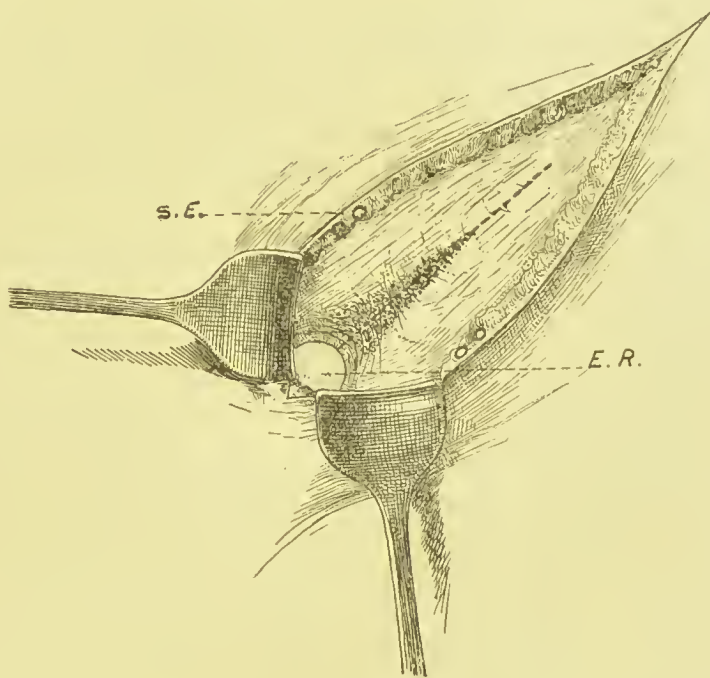


Fig. 426.—RADICAL CURE OF HERNIA.

Incision over the left inguinal canal, ending below at E.R., the external ring. The weak portion of the aponeurosis is shaded; the dotted line passes through this and indicates the cut made in the external oblique. S.E., Superficial epigastric vessels divided.

be done or not the cremasteric covering of the cord must be opened in order that the hernial sac may be reached. The sac is almost invariably found in front of the main structures in the cord, and, if empty, is distinguished by its white colour and well-defined edge from the connective tissue, etc. which surrounds it.

Methods of Dealing with the Hernial Sac.—Two rules may be laid down: First, the contents of the sac must be wholly returned within the abdomen; second, the sac itself must be isolated right up to the internal ring. With regard to the

contents, but little difficulty is usually met with in reducing intestine. In some exceptional cases of hernia of the cæcum or sigmoid flexure it may be necessary to dissect off adhesions to the posterior wall; but any small intestine is readily returned and prevented from protruding during the further step by sponge pressure. Occasionally the bladder projects into the hernial sac on its inner side, and special caution should be exercised lest it should be opened during the dissection—an accident which has happened in many cases. Whenever a thick, fat-covered elevation is found on the inner side of the sac, the nature of which is not easy to determine, the surgeon should suspect a hernia of the bladder, and carefully refrain from cutting into it to demonstrate its nature. Torsion and displacement of the neck of the sac should be practised with due caution when a protrusion of the bladder is suspected. If by accident the latter be incised, the wound should be sewn up with Lembert's sutures and provision made for drainage of the wound. Retention of a catheter is not necessary. Several such cases have recovered without leakage or other complication. The bladder, after all, but rarely causes any difficulty in herniotomy, though Curtis and Gibson have collected records of 103 cases in which it was wounded during the operation, with a direct mortality of 12 per cent.

Much more frequently the omentum gives trouble, owing to its adhesions or to its local hypertrophy.* It is essential that the omentum should be freed completely, and, if necessary, the protruding part is excised after securing its neck by several catgut ligatures. This should be done slowly and carefully, as in several instances death has followed the slipping of a ligature from the omental pedicle. The latter should never be used to plug the hernial orifice (as recommended by some writers), since it not only favours recurrence, but may cause trouble by dragging down the transverse colon and stomach, or even lead to fatal intestinal obstruction.

* In dealing with adherent omentum it is often best to disregard the lower adhesions, and commence with the pedicle, where they will probably be absent. After ligature and division of this the omentum in the sac can be removed in one piece with the latter. This method is still more useful in umbilical hernia.

It is further important that the ligatures should not be placed too close to the large intestine, and that they should be thoroughly aseptic. Peritonitis has been known to result from the application of an infected ligature to the omental stump. Fine catgut, very securely knotted, answers best, and when the operator is satisfied that there is no bleeding from any vessel in the omental pedicle the latter is gently pushed up into the abdomen. After its return it is a good precaution to introduce a small sponge on a holder through the internal ring to make sure that there is no hæmorrhage.

The sac is now isolated from the cord; the higher up this is commenced the easier it is to effect. The spermatic vessels and the vas deferens are, as a rule, spread out around the sac, especially on its posterior aspect. In congenital herniæ they may project into its interior covered by a fold of peritoneum. Their separation is mainly accomplished with forceps, which are used to peel off the vessels without actually taking hold of them. The left index finger introduced into the sac will facilitate the procedure. The separation is effected transversely to the neck of the sac. When once this is done, the constituents of the cord can be readily detached in an upward and downward direction.

If the hernia be of the congenital form the lower end of the sac is sewn up with fine catgut so as to complete the tunica vaginalis. In an adult, if the sac extends down into the scrotum it is unnecessary to follow it there. The upper part only should be isolated and divided. In many cases, however, the whole sac is freed up to the internal ring by blunt dissection, the position of the ring being recognised by the deep epigastric artery and vein. The procedure introduced by MacEwen of folding up the sac and making a pad, which is kept in place by a deep suture, is rarely employed, and does not appear to have any special advantage. One of the following methods is to be adopted in preference :—

1. The sac is ligatured as high as possible with catgut or kangaroo tendon, which for security may be passed through

its neck and tied with the Staffordshire knot. The ends are cut short, and the stump left to itself.

2. The sac being ligatured in the manner described, each end of the ligature is successively threaded on a mounted needle with its eye close to the point. Guided by the left index finger the needle is made to transfix the transversalis and oblique muscles at two adjacent points at least an inch above and to the outer side of the internal ring. The threads, being drawn

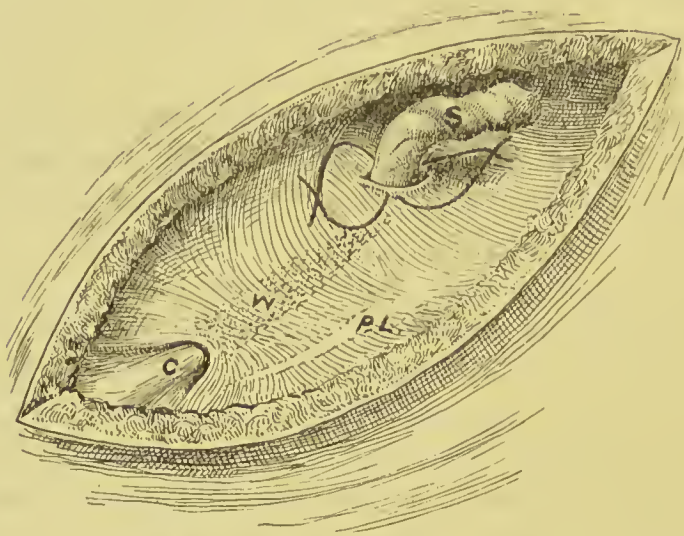


Fig. 427.—RADICAL CURE OF HERNIA.

P.L, Poupart's Ligament ; c, Spermatic cord. The stump of the sac (s) has been twisted and brought through a small opening made in the muscles, where it is fixed by two deep sutures which are shown not yet secured. The dotted area w indicates the thin portion of external oblique aponeurosis which is divided if the canal be opened up.

through on the superficial aspect of the muscles, are now tied together so as to fix the stump away from the inguinal canal. It will be understood that the stump of peritoneum is not itself drawn through the abdominal wall, but simply anchored behind the latter well away from the site of its former protrusion.

3. The sac is held by pressure forceps and twisted on its long axis several times. The left index finger is passed upwards along the canal under the oblique and transversalis muscles and a small incision made over its tip so as to allow a pair of forceps to be introduced from without inwards. The forceps are then opened and made to grasp the twisted sac, which is now drawn through the opening and securely fixed there by

tendon stitches which maintain the torsion (Fig. 427). It will be understood that the opening is placed well to the outer side and above the internal ring, that it is completely plugged by the twisted sac, and that the superfluous portion of the latter is cut away.

Unless the sac be unusually thick, this method is a very good one, and no recurrence ever takes place at the site of the small incision. The advantage of torsion in tightening up the peritoneum in this region has been especially pointed out by Sir Charles Ball of Dublin and Prof. Kocher of Berne.

4. In a few cases where the abdominal opening of the hernia is exceptionally wide, it may be advisable to sew it up with catgut instead of ligaturing or twisting the sac. This applies to ventral as well as to ordinary inguinal herniæ.

It is doubtful which of the first three methods given above is really the best, though personally we incline to the second, which includes torsion with high ligation for most cases, the chief exception being those in which the sac is so thick that it would be difficult to bring it through any small incision in the muscles.

Methods of Narrowing or Obliterating the Inguinal Canal.—Three methods will be described :—

1. Suturing the conjoined muscles to Poupart's ligament with replacement of the cord in the inguinal canal (Bassini's method).
2. Suturing the conjoined muscles to Poupart's ligament in front of the cord.
3. Complete obliteration of the inguinal canal.

In young children and adults in whom the inguinal canal has not been stretched by the frequent descent of a hernia—in other words, those in whom the parts are normal but for the presence of a congenital pouch of peritoneum—it is only necessary to deal with the sac in the manner described.

But in most cases where the radical cure is required, it is advisable that the canal should be narrowed, and considerable changes in the methods of doing this have been made during the last ten or fifteen years. Formerly narrowing sutures were placed in the external ring alone, or with the addition of

one or more which drew the conjoined tendon over towards the external oblique in front of and above the cord. To place these stitches correctly without exposing the deep muscles by slitting up the external oblique is a difficult matter, and the external ring is not really at fault in the production of a hernia ; it is, moreover, easy to narrow this opening too much with injurious effects upon the circulation through the cord. Of the three methods described, one includes the obliteration of the inguinal canal, the other two its narrowing at the upper end. It is both unnecessary and impossible to describe the host of modifications to which various surgeons' names have been attached.

1. *Method of Suturing the Conjoined Muscles to Poupart's Ligament with Replacement of the Cord in the Inguinal Canal.*—The aponeurosis of the external oblique is divided parallel to and above Poupart's ligament from the external ring to a point just above the internal ring. The cord is thus exposed surrounded by the cremasteric fibres, and the lower edge of the internal oblique muscle is clearly defined as it arches over the cord. The latter is then lifted mainly by blunt dissection from its bed, and at the same time the inner surface of the external oblique is defined and cleared both upwards and downwards, so that the strong band which forms Poupart's ligament is thoroughly exposed. The cremasteric layer is then opened so that the sac can be isolated and dealt with by one of the methods already described. Any surrounding fat may well be removed, but unless a varicocele exists, it is unnecessary (as sometimes advised) to excise any of the veins of the cord. The cord is lifted up by two blunt hooks, which are held by an assistant, and a series of interrupted sutures of kangaroo tendon is passed through the lower edge of the muscles that go to form the conjoined tendon, and through the inner edge of Poupart's ligament (Fig. 428). These sutures are introduced in a series before any one of them is tied. They all lie beneath the cord, and care must be taken in passing the curved needle through Poupart's ligament that the iliac vessels are not interfered with. By securing these sutures the internal ring is narrowed. The cord is now replaced

and the two edges of the cut external oblique are sewn together again over the cord. The ilio-hypogastric nerve must be avoided, or, if preferred, it may be resected. Finally, any subcutaneous vessels which have been held in pressure forceps are ligatured with fine catgut if necessary, and the wound is closed in the ordinary manner with silkworm-gut sutures without drainage. A sterilised dressing is applied with firm pressure, whilst the thigh is kept somewhat flexed. It is rarely necessary to remove the spica bandage until the tenth day, when the silkworm-gut sutures are removed and a pad and bandage reapplied. At the end of a fortnight to three weeks the patient may be allowed up. No truss should be worn.

The method just described is not applicable to all cases. In some the conjoined tendon is poorly developed, and in some it can only be fixed

to Poupart's ligament with difficulty. This implies subsequent tension and strain when the patient uses his abdominal muscles.

2. *Method of Suturing the Conjoined Muscles to Poupart's Ligament in front of the Cord.*—By the previously described method the surgeon narrows the upper opening of the inguinal canal to any desired degree, but it is not suitable for all cases, owing to the difficulties of bringing down the internal oblique and transversalis muscles to Poupart's ligament without undue tension. The following method avoids this; it consists in "restoring the valvular action" of these muscles by giving them a lower attachment in front of the cord. It is, in fact,

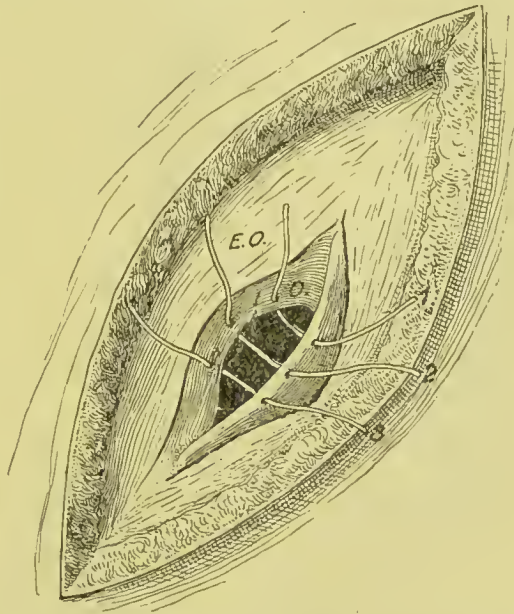


Fig. 428.—RADICAL CURE OF HERNIA.

The aponeurosis of the external oblique has been divided. Three deep sutures (1, 2, 3) have been passed through I.O., the internal oblique, the transversalis, and Poupart's ligament. E.O., External oblique. The spermatic cord has been purposely omitted in this figure for the sake of clearness.

Sir William MacEwen's original operation performed after the canal has been laid open, and has therefore the advantage that the sutures are passed with greater ease and certainty. It is unnecessary to open up the external ring, though whether this is done or not is a matter of small importance.

It is assumed that the external oblique has been divided parallel to Poupart's ligament, that the lower edge of the conjoined muscles where they arch over the cord has been thoroughly exposed and isolated, and that the hernial sac has been dealt with in the manner described above. The lower portion of the external oblique, including the external pillar of the ring, is now held up with forceps, and a curved needle carrying a strong piece of kangaroo tendon (some surgeons use stout catgut, others silk) is passed from without inwards through the external oblique just above Poupart's ligament. The needle is then made to traverse the lower edge of the conjoined muscles from within—*i.e.* from their abdominal aspect—and back again, a quarter of an inch nearer the middle line. It is now passed through the external oblique the same distance from the original point of entrance.

Thus the so-called mattress suture is completed; the needle is released, and the two ends of the suture are held in a pressure forceps until ready for tying. A second and a third loop of suture are then introduced in the same way, all of them passing in front of the cord, which need not be raised from its normal position in the canal. Two points must be attended to—the ilio-inguinal nerve must not be included in any of the sutures (as it is very apt to be), and the suture material must be perfectly aseptic and not too thick.

The sutures are now tied and the lower edge of the muscles is thus brought down in front of the cord. It only remains to sew up the divided external oblique.

A modification of this method, especially suitable for inguinal hernia in women, consists in passing a series of interrupted tendon or silk sutures through the lower portion of the external oblique, then through the conjoined muscles from within outwards, and finally through the upper part of the external oblique. These sutures should be placed very near to

each other, and as the external ring is approached the external oblique only should be included.

It is presumed that aseptic healing occurs. Under these circumstances the buried sutures may be relied on to last long enough for all purposes, whether kangaroo tendon or silk has been used. It

is often asserted that the tendon is quickly absorbed. In reply to this we would merely say that we have found it almost unaltered three and four years after it had been inserted. The small knots made in sewing up the external oblique with tendon can always be felt through the skin many months after the operation. In fact, the surgeon need be in no fear that

by opening up the canal and subsequently suturing its walls he has weakened it at all, provided that aseptic healing be secured.

3. *Complete Obliteration of the Inguinal Canal.*—The cord being freed from the internal ring down to the os pubis and the sac having been dealt with, the cord is held forward by blunt hooks, and a series of sutures is passed through the edges of the external oblique, the internal oblique, and the transversalis on the one side, and the lower part of the external oblique on the other side (Fig. 429). The lowest



Fig. 429.—RADICAL CURE OF HERNIA. (After Kelly.)
Complete obliteration of inguinal canal by sutures. The spermatic cord is held forward on a hook.

sutures will pass only through the former pillars of the ring. Room must be left at the upper end for the cord, which is now placed on the outer surface of the external oblique. If necessary, one or two stitches may be passed above the new aperture for the cord, but it is a mistake to make this unduly narrow, as the circulation of the testis will be interfered with. There is no reason for the proposal to excise any of the spermatic veins unless there be a coincident varicocele.

The stitches should be placed close together, and whilst some advocate silk as the material, we strongly recommend kangaroo tendon. When the latter material is used and due care taken as to asepsis, it is possible to perform a hundred successive operations for radical cure without the slightest trouble arising from a single stitch. The same can hardly be said if silk be used.

A word of caution is necessary as to the deep epigastric vessels. In passing the uppermost sutures it has happened that the epigastric artery has been wounded and most serious hæmorrhage ensued, even necessitating ligature of the external iliac artery. It should also be noted that the lowest suture is not placed close to the os pubis, as the pillars cannot here be approximated, nor is it necessary to attempt it.

In the female the round ligament may be disregarded and the canal obliterated completely.

When raising the cord in the male by blunt hooks in order to pass the sutures, it should be remembered that occasionally thrombosis of the spermatic veins has been produced—an accident which may also follow undue narrowing of the aperture made for the cord. Beyond the formation of a hard lump above the testicle and possibly œdema of the scrotum, little harm is likely to result, but in one or two cases symptoms of pulmonary embolism have been recorded. Hence the operator should be careful to avoid undue traction on the spermatic vessels during the operation, and also to allow sufficient room for their passage through the abdominal wall.

After the sutures have been tied and cut short, and the cord has been replaced over them, three or four fine catgut

ligatures are usually required for the superficial vessels. The skin wound is then sewn up with silkworm gut.

In **congenital inguinal hernia** the sac is first isolated from the cord, and this is by far the most difficult part of the operation, since not only is the sac wall thin, but the spermatic vessels and the vas closely adhere to it, either projecting into or being spread out around it.

Nevertheless, by patient dissection with toothed forceps and fine probe, it is always possible to separate the sac from all the constituents of the cord at some point, and when once this has been effected it is easy to continue the separation upwards and downwards. In young children the vas deferens is a very slender structure, and may easily be divided if the knife be used during the separation of the sac. The latter process must be complete—*i.e.* no peritoneal covering must be left on the cord, otherwise recurrence of the hernia will probably take place. The isolated sac should now be divided transversely about an inch above the testicle. The lower part is formed into a tunica vaginalis. The upper is pulled down as far as possible, and dealt with exactly as the sac of an acquired hernia, additional precautions being necessary to clear the cord at the internal abdominal ring. It is freed of its connections, and placed as a pad on the abdominal aspect of the circumference of the internal ring, or, better, twisted up and securely fixed by tendon or catgut sutures in a small aperture made in the oblique muscles above and to the outer side of the internal ring.

Dressing and After-treatment.—A drainage-tube is never required. A light dressing of sterilised gauze is kept in place by a spica bandage, firmly applied when the thigh is slightly flexed at the hip-joint. A piece of macintosh or other protective is secured over the whole in the case of young children, to avoid the chance of accidental contamination of the dressings from without. The dressing is not disturbed for from ten to fourteen days, when the skin sutures are removed. As soon as the wound is soundly healed, the patient is allowed up wearing a pad and bandage. At the end of three weeks he may get about as usual, but he should avoid any hard work for another three weeks.

Complications.—Retention of urine is not infrequent for a few days after the operation, and may require the use of a catheter. Provided that no irritating material has been used for the deep sutures, there are hardly any other complications to be feared. If, however, thick silk has been employed, the surgeon must not be surprised at the occurrence of sinuses, which may persist for months until the sutures come away.

The anæsthetic is the chief risk, especially if the patient be stout and inclined to bronchitis. For this reason the operation is sometimes performed under local anæsthesia (the infiltration method or ordinary injections of 2 per cent. solution of eucaine). Mr. A. E. Barker and others have recorded successful operations of this kind, but it is probable that a general anæsthetic will continue to be employed in all but a small proportion of cases in which there is some special contra-indication to its use.

Should a Truss be Worn after the Operation?—The answer to this question in the great majority of cases is certainly in the negative. As a rule the radical cure is thoroughly effective, no recurrence takes place, and the main object of the operation would be lost if the patient were compelled to wear a truss. In certain exceptional cases—for example, a direct hernia in a subject with lax abdominal wall—a light truss may be advisable.

Modified Procedures adapted to Cases of Strangulation.—Any one of the above described operations may be, and has been, carried out in cases where the hernia is exposed for the purpose of relieving acute strangulation.

It will be obvious, however, that in many cases of strangulation the time spent over the operation is of considerable importance, and that in a patient who is greatly exhausted by a long continuance of urgent symptoms, it would not be wise to attempt to carry out so elaborate an operation, for example, as that last described.

In certain of the most severe cases the gut is found to be gangrenous, and the question of an operation for radical cure does not arise. To render it possible, the gut would have to be resected, and the divided ends united: the parts would be

restored to the abdomen, and then the treatment of the sac, which had contained the putrid bowel, could be commenced. Upon such a long and hazardous procedure few surgeons would probably care to embark, especially as the patient would be already much exhausted.

In cases which are less urgent, but are still in such a position that the operation needs to be completed in as short a time as possible, it will usually suffice merely to ligature the neck of the sac, and then to close the wound, or at the most to dissect away the sac after the ligature has been applied.

Cases so treated often do as well, so far as the radical cure of the rupture is concerned, as cases dealt with by a more elaborate method.

In instances in which the operation for the relief of the strangulation is carried out, in what may be termed favourable circumstances, one or other of the operations already described may be performed.

As the operation for strangulated hernia has usually to be carried out at a moment's notice, that measure which is the least complex has much to recommend it. A surgical emergency is not the best time in which to recall the various steps of a complicated operation.

II.—THE RADICAL CURE OF FEMORAL HERNIA.

The sac is first completely isolated up to the femoral ring. Should it contain adherent omentum, the latter is separated and returned within the abdomen. The neck of the sac is then transfixed by a mounted needle threaded with kangaroo tendon or stout catgut, the needle is withdrawn, and the ligature securely tied around the sac, which is then cut away below it. Each end of the ligature is then threaded on the handled needle, which is introduced from below upwards through the abdominal wall just above Poupart's ligament, and the two ends are knotted together in front of the external oblique, so as to draw the pedicle away from the femoral ring.

If the neck of the sac has but little fat around it and is therefore of slender proportion, it may conveniently be twisted and

fixed by sutures in a small aperture made just above Poupart's ligament. In either case the passage of the ligatures or of the twisted sac through the lower edge of the abdominal wall is rendered easy and safe by the introduction of the left index finger into the femoral ring to act as a guide.

As a rule, especially if the femoral ring be large, an attempt should be made to narrow the latter by sutures passing through Poupart's and Hey's ligaments in front and the fascia over the pectineus muscle behind. During the introduction of these sutures the femoral vein on the outer side is carefully guarded with the finger. Some surgeons use two or more interrupted sutures; others employ the purse-string method.

Many other plans have been proposed for dealing with the femoral ring. Thus a small flap of the external oblique aponeurosis has been turned down and sewn to the pectineal fascia, or a flap of the pectineus muscle has been turned up and sewn to Poupart's ligament. The muscle, however, makes an unsatisfactory kind of shutter, and probably atrophies in a short time. The conjoined tendon is also sometimes drawn down and sewn to the pectineal fascia.

In most cases of femoral hernia, dealing thoroughly with the neck of the sac as high up as possible in the manner described suffices to produce a radical cure; but, provided that the ring can be narrowed by deep sutures without undue tension on the latter, it is certainly an additional safeguard to employ them.

The great majority of cases are in women, but should the operation be performed on a man the presence of the spermatic cord just above Poupart's ligament will demand extra care in passing the deep sutures, etc.

III.—THE RADICAL CURE OF UMBILICAL HERNIA.

Comparatively few operations have been devised for the treatment of umbilical hernia. Certain of these—such as the ingenious procedure of Professor Wood by means of subcutaneous ligature—have been entirely superseded.

The method already described in a previous section

(page 544) possesses the advantages of simplicity, completeness, and efficiency.

RESULTS OF OPERATIONS FOR RADICAL CURE.

It would be impossible to attempt to form any conclusion as to the value of one method when compared with another by criticism of the statistics of the various operations which have been from time to time published. No one method can be rigidly adhered to, or be considered to be all-sufficing. So far as published accounts extend, it could readily be maintained that no one operation is to be preferred to another. Each surgeon will select his method according to his particular surgical bias, and according to the nature of the special case in hand. In process of time it will probably be made evident that some one method—either among those already described, or among such as may be evolved in the future—has claims to be considered as the best means of treatment, but at the present time it would be premature to attempt to predict in what direction this uniformity of opinion will tend.

Mortality of the Operation.—In properly selected cases and in practised hands the operation may be said to be free from risk. It would be easy to quote statistics of two hundred or more consecutive cases of radical cure from the experience of various surgeons without a single death (provided the cases in which strangulation was present were excluded).

In fact, the occurrence of a death from the operation of radical cure in a normal subject is a “surgical calamity.” The greatest risk is incurred in operating on young children or on elderly subjects with chronic bronchitis, etc.; or chronic kidney disease; and in neither of these latter should such an operation be undertaken as a rule; whilst in infants the operation is but rarely required. Umbilical hernia furnishes but a small proportion of the cases, and owing to the usual physical character of the patients, the risk is decidedly higher than in inguinal or femoral hernia.

Chances of Recurrence after Operation.—It is useless to be dogmatic on this matter. There is no form of hernia in

which recurrence will not sometimes be met with after operation, whatever method has been employed. Moreover, whilst the part operated on may remain free for many years, a second hernia is apt to develop at some other abdominal opening, perhaps on the other side of the body. This has often been observed. Nor can any "time limit" of safety from recurrence be laid down, as a man may work hard without a truss for five or ten years after operation and then develop a recurrence.

The forms of hernia most difficult to cure permanently by operation are the umbilical and the true direct inguinal; then comes femoral hernia, whilst ordinary inguinal hernia is the easiest to cure (especially in healthy young adults or boys).

Relapse is so frequent after operation on large umbilical or large femoral herniæ that such a patient should always be advised to wear subsequently a light belt or truss. On the other hand, after operation on indirect inguinal hernia the case cannot be considered radically cured unless the patient can dispense with a truss.

It will probably not be far from the mark if the percentage of recurrence at the site of operation or elsewhere be expressed as follows:—

Inguinal, 20 to 30 per cent. (including direct hernia).

Femoral, 30 to 40 per cent.

Umbilical (in adults), 50 to 60 per cent.

At the same time it is not uncommon to hear a surgeon state that he has never known of recurrence in his patients—a statement which may be to some extent true, and yet misleading.

Part XI.

OPERATIONS UPON THE BLADDER.

CHAPTER I.

LATERAL LITHOTOMY.

THE operations of lateral and median lithotomy which at one time held so important a place among surgical procedures have now almost vanished from modern practice, and have been replaced by lithotritry or litholopaxy to a very great extent.

History of Lithotomy.—The operation of cutting for stone is of great antiquity, and dates from a period long before the Christian era. The earliest method, and the one which was practised for some twenty centuries, was that known as the operation of Celsus, or the apparatus minor, and as cutting on the gripe. The first title is based upon the very definite description of the operation given by Celsus, and the second is derived from the fact that very few instruments were employed in the execution. In cutting on the gripe, the stone was fixed by means of two fingers introduced into the rectum. It was thus held against the neck of the bladder, and was made to bulge towards the perineum. Upon the stone thus gripped the surgeon cut through the perineum. The incision was transverse, or curvilinear, and was made without any precise anatomical knowledge.

The operation known as the Marian operation, or as the apparatus major, was described in 1524 by Marianus Sanctus. He was a pupil of Johannes de Romanis, by whom the procedure was invented. Many instruments were employed, and hence the name, the apparatus major.

The most important of these was the itinerarium, or grooved staff.

Although in the earlier operations attempts were made to avoid actual section of the neck of the bladder, yet the procedure differed but little from the modern method of lateral lithotomy. This

procedure may be considered to have actually originated with Jacques Baulot, commonly known as Frère Jacques. He was born in 1651, and died in 1714.

The median operation as now practised was first performed early in the nineteenth century by Manzoni, of Verona. It was especially elaborated in England by Allarton, and the method is often known by his name.

The high operation, or suprapubic lithotomy, appears to have been first carried out by Franco in 1556. His operation was, however, not conducted upon very precise grounds.

The method was brought into prominent notice by Frère Côme, the inventor of the *sonde à dard*, who performed many lithotomies by this plan between the years 1758 and 1779. It was carried out in England in 1719 by John Douglas, and Cheselden's well-known memoir upon the high operation appeared in 1723. Although practised by such operators as Vidal de Cassis, Valette, and Morand, the procedure received little support until recent times. Its present prominent position is due to two facts—to the introduction of improved methods of treating wounds on the one hand, and to the demonstration of methods of bringing the bladder into position above the symphysis on the other. The latter investigations originated with Dr. Garson (*Edin. Med. Journ.*, October, 1878) and Dr. Petersen, of Kiel (*Archiv f. klin. Chirurg.*, 1880, xxv.). With the publication of the anatomical researches and experiments of these two investigators the rapid and remarkable development of the present successful operation of suprapubic lithotomy may be said to commence. Petersen and Garson showed that by means of a rubber bag introduced into the rectum and then inflated the bladder can be pushed forwards against the abdominal wall. However, as a matter of fact, the use of the rubber bag was abandoned before long, as in suprapubic cystotomy all that is necessary is to ensure the bladder being distended with water (*see* page 593). Several lamentable accidents have followed the employment of the rectal bag.

Anatomical Points.—The perineum is a lozenge-shaped space bounded by the symphysis, the rami of the pubes and ischia, the ischial tuberosities, the great sacro-sciatic ligaments, the edges of the two great gluteal muscles, and the coccyx.

This bony framework can be felt more or less distinctly all round, and in thin subjects the great sacro-sciatic ligaments can be made out beneath the gluteus maximus muscle.

The anus is in the middle line between the tubera ischiorum, its centre being about one inch and a half from the tip of the coccyx. The raphe can be followed from the anus along the

middle line of the perineum, serotum, and penis. No vessels cross this line, and therefore a median perineal incision is comparatively bloodless.

In the raphe, midway between the centre of the anus and the spot where the scrotum joins the perineum, is the "central point" of the perineum. The two transverse perineal muscles, the accelerator urinæ, and the sphincter ani, meet at this point, which also corresponds to the centre of the inferior edge of the triangular ligament. The bulb is just in front of it, as is also the artery to the bulb; and in lithotomy, therefore, the incision should never commence in front of this spot.

When the body is in the lithotomy position, it may be taken that the bladder is, in the adult, from two and a half to three inches from the surface of the perineum. The prostate is situated about three fourths of an inch below the symphysis pubis.

In lateral lithotomy the parts cut in the *first incision* are the skin and superficial fascia; the transverse perineal muscle, artery, and nerve; the lower edge of the anterior layer of the triangular ligament; the external hæmorrhoidal vessels and nerves.

In the *second incision* the parts divided are the membranous and prostatic portions of the urethra, the so-called posterior layer of the triangular ligament, the compressor urethræ muscle, the anterior fibres of the levator ani, and the left lateral lobe of the prostate.

The artery to the bulb is a vessel about the size of the posterior auricular. It runs inwards between the fibres of the constrictor urethræ muscle. It may be small, or wanting on one side, or even double. It may arise from the accessory pudic, in which case it lies farther forwards than usual, and is well removed from the field of the operation. On the other hand, it may come off from the pudic earlier than usual, and may cross the perineum farther back, reaching the bulb from behind. In such a case it can scarcely escape division in lateral lithotomy.

The bulb is very small in children, is large in adults, and usually largest in old men. The hæmorrhage that is stated

to attend the wounding of it has possibly been exaggerated, and has most probably proceeded from a large artery to the bulb. If the incision be kept well behind the "central point" of the perineum, the bulb can be in little danger.

In the second incision the knife may be passed beyond the prostate, and may so incise the visceral layer of the pelvic fascia as to open up the pelvic cavity. It will be understood, however, that the lateral lobe of the prostate may be cut freely without this cavity being endangered. The gland is enveloped by the pelvic fascia, but the incision made into the prostate is, or should be, well below the superior reflection of the membrane. The incision in the neck of the bladder should be strictly limited to the prostate.



Fig. 430.—LISTON'S LITHOTOMY STAFF.

The prostatic plexus of veins can hardly avoid being wounded. The left ejaculatory duct may be cut if the prostatic incision be carried too far backwards.

The actual extent by measurement of the incision in the prostate is difficult to define. The largest diameter of the gland is transverse, is at the base of the body, and measures one inch and a quarter to one and three-quarters. Vertically along the urethra the prostate measures from one inch to one inch and five-eighths.

Dolbeau showed that the neck of the bladder cannot be dilated to a diameter greater than 20 to 24 mm. without producing lacerations of the prostate and vesical neck. Twenty-four millimetres is just short of one inch, and a stone with a diameter of one inch cannot therefore be drawn through the neck of the bladder without effecting some tearing of the parts.

Instruments Employed. — The fewer the instruments employed, and the simpler they are, the better.

The following list represents the full series of instruments required:—Grooved staff; lithotomy knife; probe-ended bistoury; lithotomy forceps and scoop; lithotomy tube; sound; probe; pressure forceps; syringe; anklets. To these may be added a petticoated tube or tampon and a lithotrite.

The Staff.—The curved staff with lateral groove, commonly known as Liston's, is the one usually employed (Fig. 430). It should be of moderate size, since a large instrument opposes the introduction of the finger. The point should be blunt. The groove should be wide, rather than deep, and should end abruptly about one-quarter of an inch from the end of the staff. The curve of the instrument must depend upon individual taste. Some surgeons prefer the old-fashioned long



Fig. 431.—LISTON'S LITHOTOMY KNIFE.

curve (Fig. 430); others, and among them Mr. Cadge, prefer a staff with not too long a curve.

The Knife.—The best and simplest knife is that known as Dupuytren's, or Liston's (Fig. 431). The back is nearly straight, the point is central, the cutting edge extends about one inch and a quarter from the tip. The blade is stout, and measures some three inches, while the handle is four inches in length. This knife suffices for the whole operation.

The Forceps.—The straight pattern of forceps is the most useful. Curved forceps are very seldom necessary. The blades should be roughened inside. The blades are spoon-shaped, and the extremities of the spoons should not touch when the instrument is closed, so that any pinching of the bladder may be avoided. The ring in one handle is for the thumb, while the crook in the other handle is for the fingers. Forceps of various sizes may be required. Curved forceps are only called for in some cases in which the stone is lodged behind a large prostate.

The Scoops.—Scoops of various sizes are of service. They

should be fixed in substantial handles, and should be well curved (Fig. 432).

The crested scoop shown in Fig. 432 has a very convenient scoop extremity. The handle-end is probe-pointed, and can be passed into the bladder by following the groove on the staff, or the wall of the urethra. When the instrument has been introduced, the crest serves as a guide to the forceps, whose closed blades are yet sufficiently separate to receive the crest between them. This part of the instrument may be useful to beginners.

The Lithotomy Tube.—This tube is introduced into the bladder after the operation, to ensure rest to the bladder and perfect drainage. Cadge's tube is the best. It is a double silver cannula, sheathed so that it can be drawn out according

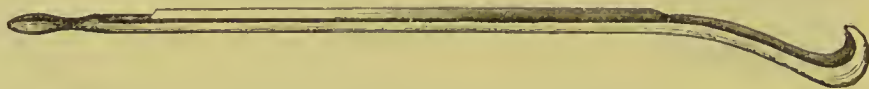


Fig. 432.—THE CRESTED SCOOP.

to the distance of the bladder from the surface. It has about the diameter of a No. 18 catheter, and has a well-bevelled end, which is perforated with numerous small holes for about an inch.

The petticoated or shirted tampon is a tube around the end of which is fastened a "petticoat" of linen, which is well oiled. In cases of persisting hæmorrhage this tampon may be employed in place of the ordinary tube. After it has been introduced, the conical space between the "petticoat" and the tube is well plugged with fine gauze. The wound can thus be plugged firmly without interfering in any way with drainage from the bladder.

The Anklets employed to fix the patient in the lithotomy position are those known as Pritchard's. Clover's crutch may be used for the same purpose. It is more quickly applied, it holds the patient more steadily, and enables the operator to do with at least one assistant less. It has, however, the disadvantage that the bar comes in the way of the staff and of the assistant who is responsible for holding it.

Preparatory Treatment—It is assumed that the stone will

have been demonstrated by sounding and by skiagraphy. Little special treatment is called for. It may be represented by absolute rest in bed for some few days before the operation, and by a simple and judicious diet. It is most desirable that the rectum should be quite empty. It should be ascertained that the whole of the enema has been returned. A hip bath on the eve of the operation is desirable. If the urine be putrid, the bladder may be washed out twice daily during the period of resting. It is most desirable to get the urine into as healthy a condition as possible before operating. This applies to all cutting operations on the bladder or urethra. A course of salol or urotropin given internally for some days has a most beneficial effect.

Placing of the Patient in Position, and Introduction of the Staff.—The anæsthetic is administered, and as soon as the patient is insensible the anklets and wristbands may be applied. The patient is now brought down to the end of the table until the buttocks are projecting over the actual foot of the table. In this position, and while the legs are hanging towards the floor, the staff may be introduced. As soon as it is in place, the knees are very carefully brought up towards the chest, and the patient is fixed in the lithotomy position. It is very undesirable to introduce the staff while the patient is lying flat upon the table, and before any step has been taken to bring him into position. The rough movements necessary may cause the staff to damage the bladder or urethra. If the staff be introduced as above advised, all the rough movements are over, and nothing remains but to gently flex the thighs upon the pelvis.

The assistant who introduces the staff must not take his fingers off the instrument until it is finally removed from the bladder. The staff may be introduced after the patient has been placed in the lithotomy position, but the manœuvre is less easy to execute. When a Clover's crutch is used in place of the anklets, it is almost impossible.

The patient being in the well-known lithotomy position, the surgeon seats himself beyond the end of the table, his face being on a level with the patient's perineum.

Two assistants are required to support the legs, and it is their duty to see that the patient is kept immovable, that the median line of the perineum is exactly vertical, and that the knees are symmetrically separated.

A third assistant is responsible for the extremely important duty of holding the staff; and to the exact performance of this office he should devote his entire attention.

A fourth assistant may stand by the surgeon's side, to hand instruments, etc.

The presence of the stone should be verified by the staff or by a sound previously introduced.

The staff is held quite perpendicularly, and its concavity is drawn well up against the bony arch of the pubes. It is held rigidly and exactly in the median line. The assistant's thumb is placed upon the rough handle, while his fingers grasp the shaft. There must not be the least rotation of the instrument to one side or the other. In this position it is held throughout the operation and until it is withdrawn. The assistant at the same time holds up the penis and scrotum, and sees that the perineal raphe is exactly vertical.

The Operation. — *First or Superficial Incision.*—Steadying the integuments of the perineum with the fingers of the left hand, the surgeon makes the first incision. The knife is introduced at right angles to the surface of the perineum, and at a point just to the left of the median raphe, and just behind the central point of the perineum—*i.e.* in the adult about one inch and a quarter in front of the anus. The knife is thrust in the direction of the staff, and its point may just hit the staff. This first movement is of the nature of a stab or a puncture.

The incision is completed as the knife is withdrawn. It is carried downwards and outwards into the left ischio-rectal fossa, and ends at a point between the tuber ischii and the posterior part of the anus, and one-third nearer to the tuberosity than to the gut.

The incision will in the adult be about three inches in length. It becomes gradually shallower and shallower as it proceeds outwards and backwards from the median line.

Second or Deep Incision. — The left forefinger is now introduced into the wound, and the staff felt for. This instrument will be perpendicular in position, and well drawn up against the pubic arch.

The surgeon, keeping his eye upon the staff, to appreciate its position in the depths of the perineum, slips the knife along the back of the forefinger until it hits the groove in the staff (Fig. 433).

There must be no doubt at this stage of the operation.

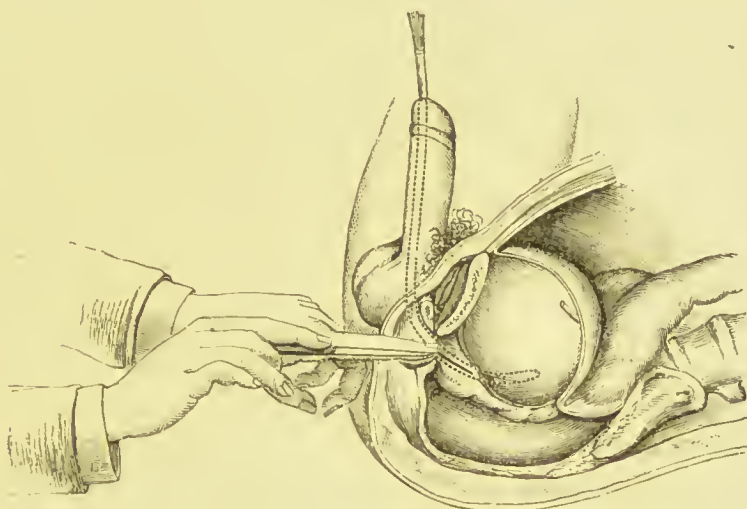


Fig. 433.—LATERAL LITHOTOMY : THE SECOND INCISION. (*Fergusson.*)

The surgeon must be assured beyond question that he has found the groove, and that the knife occupies it.

The knife is now pushed cautiously along the groove until it reaches the end of the staff and enters the bladder. The blade should be inclined laterally as it is passed along, and be kept parallel with the line of the surface wound.

The incision made in the prostate will therefore be oblique, and directed downwards and outwards.

An escape of urine and a sense of abruptly-diminished resistance will announce that the neck of the bladder has been divided.

In his anxiety not to let the knife leave the groove, the surgeon may depress the handle too much and arrest the knife by causing its sharp point to impinge against the metal. If

the hand be raised a little, the knife will glide on. It is in making the second incision that some surgeons employ a special probe-pointed bistoury.

As the knife is withdrawn, its edge is pressed gently downwards and outwards, so as to enlarge the opening made in the prostate and the neck of the bladder. The pressure employed diminishes as the knife is removed, and by the time the skin cut has reached the edge has ceased to cut.

Entering of the Bladder.—The left index finger is now introduced along the groove in the staff into the bladder. As soon as the surgeon is sure that he has his finger in the viscus, but not before, the staff is removed. The finger is then employed in dilating the neck of the bladder in all directions, and in ascertaining the size and situation of the stone.

The opening made by dilatation will have to accommodate itself to the size of the stone.

The dilatation must be made in all directions, and not only in the line of the wound. In the adult considerable force may need to be employed, especially when the incision has been unduly small.

Extraction of the Stone.—Without removing the left forefinger the surgeon introduces the lithotomy forceps along the upper or dorsal surface of the digit, and only withdraws the finger when the forceps are well in the bladder.

“The blades,” wrote the late Mr. Cadge, “should be fully introduced before opening them—this is done slowly and in a lateral direction—then, by giving a quarter turn to the handles, one blade is made to sweep round to the lower fundus of the bladder, and by this manœuvre the stone will almost certainly be caught. If it is not, the process will be repeated; and if there is still a difficulty, the surgeon will ascertain if he has not passed over the stone, which is not infrequently found close behind the prostate and beneath the forceps. If this be so, he will withdraw them slightly, elevate the handles, and repeat the rotatory movement. Sometimes, though rarely, the stone is entangled or held by irregular contraction of the bladder at the upper fundus, in which case the handles should be lowered and the blades directed upwards, while an assistant makes firm pressure

above the pubes. The large size of the stone sometimes makes it difficult to grasp it; in this case the operator will withdraw the forceps, perhaps take a larger pair, and, having ascertained with his finger the exact position of the stone, he will introduce them so that the tips of the blades impinge on it; then, by slowly opening them, they will be found to glide over each side of the stone, and a good hold is obtained.

“All these manœuvres are to be slowly and gently conducted, and there should be no wild ‘digs’ at the stone, or sudden alterations of method. The extraction should be deliberate and steady, the direction somewhat downwards, the blades and handles of the forceps kept in a vertical position, and no rotation made as the stone advances, for fear of injuring the prostate and neck of the bladder. Should there be much resistance and no sense of gradual yielding, the surgeon will ask himself the question whether this is due to an insufficient opening, or to the projection of the ends of an oval stone laterally beyond the blades. The latter may be known by observing that the bladder is brought bodily down, so that the prostate, which is probably large, is visible near the external wound; in this case the stone must be liberated, the finger again introduced, and a fresh hold taken. If the obstruction is due to a large stone and too small a wound, the latter is to be enlarged in the direction of the first incision” (Heath’s “Dictionary of Surgery”).

Dr. Keegan (*Brit. Med. Journ.*, October 15, 1887) points out that the line of traction in removing the stone should be in the line of the outlet of the pelvis. When the body is in the lithotomy position therefore, the forceps must be drawn in a direction upwards and forwards.

The bladder is finally explored with the finger for other calculi or for fragments. If any *débris* remain, such as may be broken from a phosphatic calculus, the viscus is washed out with the syringe or irrigator.

The lithotomy tube is introduced, and is secured in place by means of lateral tapes, which are fastened to the two tails of a T-bandage on a level with the perineal wound. The wound is left open and uncovered.

Lateral Lithotomy in Children:—The operation in children is much modified by the anatomical conditions of the parts. The pelvis is relatively narrower than in the adult. The bladder is more an abdominal than a pelvic organ, and the neck of the bladder is therefore high up. The viscus, moreover, is very movable, and has less substantial attachments than has the bladder in the adult. The urethra is very small, its walls are thin, and all the parts are comparatively delicate and readily torn. The prostate is wholly undeveloped, and thus much of the actual neck of the bladder has to be cut. From the small size of the gland also it happens that in some cases the knife has passed too far beyond the prostate area, and has opened up the pelvic fascia. In children also the peritoneum descends lower on the posterior surface of the bladder, and may be wounded by a careless operator.

On the other hand, the staff is in children more easily felt through the perineum, the bulb is very small and insignificant, and the bladder can be more readily steadied and manipulated by the fingers pressing deeply above the pubes, or by the fore-finger introduced into the rectum.

Suitable instruments must be employed, and the surgeon must throughout exercise the utmost gentleness.

The great difficulty rests with the entering of the bladder.

If force be employed, it is possible in attempting to introduce the finger to actually tear the membranous urethra across, and to push the neck of the still undilated bladder in front of the finger into the pelvis. This accident happened to so eminently skilful a surgeon as Sir William Fergusson. Forceful dilatation of the neck of the viscus must not be attempted. The incision of the prostatic area should be relatively freer in the child than in the adult, and the operator must within reasonable limits depend more upon the knife than upon the finger in effecting an entrance. It must be understood that the incisions, although made more freely in proportion than in the adult, must yet be strictly limited.

The *modus operandi* should be as follows:—The usual incisions are made; the staff is reached, and a relatively free incision is made into the neck of the bladder. The deep wound

is examined with the finger. A pair of dressing forceps is then introduced along the staff into the bladder, and, by opening the blades, the wound in the vesical neck is cautiously enlarged. In one instance, when carrying out this step of the operation, I unexpectedly seized the stone and removed it forthwith.

The forceps are removed, and a probe-pointed director or common probe is then introduced into the bladder along the groove in the staff. The staff is withdrawn, but the probe or director is left in position, as a guide to the bladder, until the operation is completed. The finger is now introduced along the slender probe, and is slowly and cautiously wormed into the bladder. The stone may now be removed by appropriate forceps in the usual way, or its extraction may be effected by a scoop aided with the tip of the left forefinger, or the calculus may be worked out of the bladder by means of one forefinger introduced into that organ, and aided by the other forefinger inserted into the rectum.

As urinary infiltration is little to be feared in children, and as they prove restless and often unintelligent patients, the lithotomy tube may be dispensed with, and the wound left practically to look after itself.

Accidents and Complications of Lateral Lithotomy.—

1. *Failure to find the stone* may depend upon the fact that a small calculus has escaped unobserved with the first gush of urine, or a small stone may be hidden in a blood clot, or covered with a mass of mucus. Failure to find the stone has also depended upon the circumstance that it did not exist. In cases in which the result of sounding has been doubtful, either cystoscopy or skiagraphy should be employed, and the operation should not be performed unless either or both have given a positive indication of the position and size of the stone.

2. *If the stone breaks up* during the process of extraction, especial care must be taken that every fragment is removed. The scoop may be employed in addition to the forceps, and especial use must be made of the syringe. The bladder should be explored with the finger and the sound before the patient leaves the table.

In these cases, and in instances of multiple calculi, it may

be well to examine the bladder through the perineum (under an anæsthetic) at a late period after the operation, or just before the wound is beginning to close.

3. *Hæmorrhage*.—Primary hæmorrhage, although free at first, usually ceases before the last steps of the operation are completed. Bleeding from superficial vessels may be dealt with by ligature, and from certain of the deeper vessels by means of pressure forceps, which are left in position for twenty-four or forty-eight hours. Hæmorrhage from the artery to the bulb may be checked in this manner.

In other examples of bleeding from the depths of the wound, the hæmorrhage may depend upon partial division of an artery, wound of the bulb, the prostate, or the prostatic veins.

Pressure with a fine Turkey sponge of suitable size may be tried, or the wound may be flushed with iced water, or a piece of ice may be introduced into the bottom of the incision. If all these means fail, the lithotomy tube should be introduced, and the wound plugged around it with strips of fine gauze. The “petticoated tube” should be used for the purpose, in order to ensure that no piece of gauze be left in the wound.

The plugging of the wound is not free from objection. It is painful, it prevents the escape of discharges, and may lead to extravasation in the connective tissue planes about the neck of the bladder.

When secondary bleeding occurs, the patient should be placed once more in lithotomy position, and the wound thoroughly cleansed and examined. The tube should be removed, and the clots washed out of the bladder.

When the incision has been dried, it is possible that the bleeding point may be detected, especially if the perineum be in a good light and the wound margins be well retracted. In such a case pressure forceps will meet the complication. Failing the easy securing of the divided vessel, cold injections may be tried; but if they fail, as is most probable, the tube should be re-inserted, and the wound plugged with gauze.

Injections of powerful styptics, and especially of perchloride of iron, are to be absolutely condemned.

4. *Wound of the Rectum*.—This accident may happen if

the staff be not kept well up against the pubic arch, or if the incision be carried too little outwards, or if the rectal tissues be not sufficiently guarded with the finger during the making of the second or deep incision, or if the bowel be full or "ballooned." The bowel is usually wounded just above the internal sphincter. In the event of such an accident it is better to leave the wound untreated. As a rule, the accidental opening closes.

5. The following *accidents* may be classed as quite exceptional:—

The bladder has been perforated by the staff. In such cases the viscus was probably contracted, and the sound too long and too pointed.

The posterior wall of the bladder has been cut with the knife, especially when long blades have been used.

The bladder wall has been pinched up and torn with the forceps.

A false passage has been made by the staff, and upon the misplaced instrument the operator has made his incision.

After-treatment in Lateral Lithotomy.—The patient is placed on a narrow bed with a firm horsehair mattress, protected by a waterproof sheet. Beneath the buttocks are kept squares of old sheeting, which can be changed as often as they are wetted with urine. In addition to the sheets, large sponges may be employed to absorb the escaping urine. They can be readily changed without disturbing the patient, they are easily cleansed, and if plenty are employed, and each one is allowed to lie for some time in a carbolic solution before it is used again, the same sponges can be employed over and over again. They need to be well dried by heat before being applied, and may be dusted with iodoform.

A rope and handle bar suspended above the bed will enable the patient to raise his pelvis readily when the squares of sheeting are changed. The knees should be supported by separate pillows, with an interval between them. Nothing must obstruct the free exposure of the tube.

Clots in the tube may be removed with a moistened feather. If the escape of urine ceases, and there is pain about the bladder,

the tube may be pushed a little further in, or a soft rubber catheter may be introduced through it into the bladder.

In most cases the tube may be removed in thirty-six or forty-eight hours. In some few instances—especially when there have been difficulties of micturition previous to the operation—the tube may have to be retained for three or four days, or even longer.

The parts exposed to the contact of urine should be dried as frequently as is possible. The scrotum should be kept away from the perineum by a simple suspender or “crutch pad.” When the urine is alkaline and irritating, the skin of the buttocks and perineum should be smeared well with vaseline after each change of the sheets or sponges. In cases of actually putrid urine the bladder should be washed out two or three times a day with a warm solution of boracic acid. The urine begins to flow by the urethra as a rule between the eighth and twelfth day, and the perineal wound is generally healed and the patient “cured” within the month. The same care in the diet is observed as is customary after all major operations. If the bowels are not opened by the third day, a laxative should be given.

The following *complications* may occur during the after-treatment:—Retention of urine from blocking or displacement of the tube. Suppression of urine in cases in which the kidneys are diseased. Incrustation of the wound with phosphates may occur when the urine is ammoniacal and there is much cystitis. This is especially met with in aged and feeble patients. The condition is met by frequent irrigation of the bladder with boracic acid lotion or mildly acidulated solutions, and by constant attention to the wound. Epididymitis is not unfrequently met with after lateral lithotomy. Cellulitis from urinary infiltration is, of all the possible complications, one of the most serious. It is fortunately uncommon.

CHAPTER II.

M E D I A N L I T H O T O M Y .

IN this operation the knife is entered in the middle line of the perineum, just in front of the anus. The apex of the prostate and the membranous urethra are incised in the median line.

The parts divided in the median operation are the skin and superficial fasciæ, the sphincter ani, the central point of the perineum, the lower border of the triangular ligament, the membranous urethra, the compressor urethræ, and the apex of the prostate.

The advantages claimed for the operation are—the smaller amount of cutting involved, the reputed lesser amount of bleeding, and the more rapid recovery. The late Mr. Cadge, however, stated as the result of an extensive experience of both methods that troublesome bleeding is of frequent occurrence in median lithotomy, and that the rapid recovery which is claimed for the method is only to be expected when the stone is small. There are, moreover, the distinct disadvantages that both the bulb and the rectum are in greater danger of being wounded, and that the amount of space obtained for the removal of the stone is very slight. The median operation cannot be carried out in its integrity in children.

Mr. Cadge admirably summed up the position of median lithotomy in these words :—“ It is suitable only for small stones, and these are best dealt with by lithotripsy.” In a few cases a small stone habitually rests in a dilated prostatic urethra, and for these median lithotomy is well adapted.

The general features of the operation are identical with those of lateral lithotomy. A special staff and a special knife are employed.

The staff is of moderate size, and has a broad, deep median groove (Fig. 434). The knife is a long, straight, narrow bistoury, with a stiff back and a double cutting point.

Little's lithotomy director (Fig. 435) is of service.

The Operation.—The method here described is that known as Allarton's.

The patient having been placed in lithotomy position, the



Fig. 434.—LITHOTOMY STAFF WITH MEDIAN GROOVE.

staff is introduced, and is held in the same manner as in lateral lithotomy. The surgeon inserts the left index finger into the rectum, and steadies the staff with the point of the finger, which is pressed against it at the apex of the prostate.

The narrow bistoury is now thrust into the median raphe of the perineum half an inch in front of the anus. It is introduced horizontally, and with the cutting edge directly upwards.



Fig. 435.—LITTLE'S DIRECTOR.

The groove in the staff is hit at the point where it is steadied by the finger in the rectum. The groove is entered at this point, and by continuing to thrust the knife deeper the apex of the prostate is slightly incised. The membranous urethra is cut through as the knife is being withdrawn, and the external wound is enlarged to the extent of about one inch by cutting upwards as the knife is being removed.

As the urethra is incised, the handle of the knife will be pointing almost directly downwards; as the integuments are

divided, the handle will be pointing upwards. Special care must be taken to avoid wounding the bulb.

A Little's director, or similar instrument, is now introduced along the groove of the staff into the bladder. It is held in the left hand. The staff is then withdrawn.

Guided by the director, which is retained in position until the operation is completed, the operator gradually worms his right forefinger into the bladder, dilating its orifice.

The forceps are now introduced, and the stone is withdrawn.

In ordinary cases no lithotomy tube need be employed.

CHAPTER III.

SUPRAPUBIC LITHOTOMY.

Anatomical Points:—When empty, the bladder is flattened and of triangular outline, and lies against the anterior wall of the pelvis.

Between this part of the pelvic wall and the adjacent surface of the bladder is a pyramidal-shaped space filled with a loose connective tissue. On the summit of the bladder is inserted the remains of the urachus. The peritoneal investment of the viscus, so far as its anterior surface is concerned, never extends beyond the attachment of this structure.

To the bladder at its summit the peritoneum is firmly attached, but to the anterior abdominal parietes at the site of the reflection of the membrane the attachment is remarkably lax. This loose connection of the peritoneum to the parietal tissues allows the serous membrane to accommodate itself to changes in the size and position of the bladder.

The conditions under which the fold of peritoneum at the reflection can be displaced upwards, and a portion of the bladder be projected above the symphysis pubis, free of covering from the serous membrane, vary somewhat according to the age of the patient.

In the child the bladder is still rather an abdominal than a pelvic organ, its vertical axis is elongated, and its outline is more nearly oval. When distended, the organ tends certainly to project towards the pelvic floor on the one hand, while on the other it mounts readily over the symphysis pubis, and soon presents a fair non-peritoneal surface above that bone. By means of a frozen section Symington showed (*Edin. Med. Journ.*, April, 1885) that in the case of a male child aged five,

the injection of three ounces of water into the bladder caused the reflection of the peritoneum to be carried 2·7 cm. (*i.e.* more than one inch) above the symphysis pubis.

It will be evident therefore that in children mere distension of the bladder—without the aid of any rectal tampon—will suffice to bring the viscus into a safe position for suprapubic lithotomy.

About 1880 the experimental work of Garson and of Petersen led to the general adoption of the *rectal bag* in suprapubic cystotomy. It has, however, been found that the bag may well be dispensed with, and that there are several dangers and disadvantages attending its use. Hence it has been generally discarded, and no description of it is therefore called for in these pages.

The empty bladder may be found in one of two conditions (as demonstrated by Hart in the adult female bladder). It may be small, oval, and firm, with its upper wall convex towards the abdomen (the systolic empty bladder); or it may be larger, and soft, with its upper surface concave towards the abdomen, and fitting into the concavity of the lower wall or surface (the diastolic empty bladder).

When moderately distended, it is of rounded outline; when completely distended, it assumes a more oval outline, and rises out of the pelvis. As the bladder becomes distended its fundus extends more and more towards the perineum. Its summit is brought more and more in contact with the anterior abdominal parietes.

When the bladder and the rectum are both quite empty, the apex of the bladder and the prevesical reflection of peritoneum are a little below the upper margin of the symphysis pubis.

When the apex of the bladder is two inches above the pubes, and the organ is pressed against the abdominal wall, the peritoneal reflection is probably not more than three-quarters of an inch above the same point of bone.

The mobility of the bladder and the laxity of the peritoneal fold vary greatly in different individuals, and are much influenced by the physical condition of the tissues. In two males,

aged thirty-four and thirty-five respectively, an injection into the bladder of ten ounces raised the peritoneal fold in one case an inch and three-quarters, and in the other three-quarters of an inch. In fleshy and flabby subjects the bladder usually will rise easily out of the pelvis against the abdominal wall when only moderately distended.

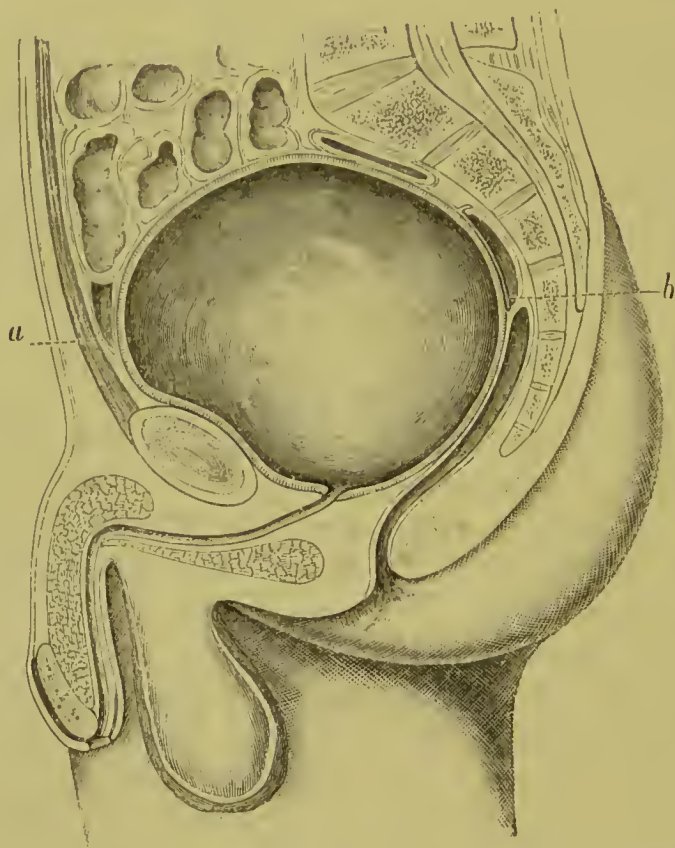


Fig. 436.—EFFECTS OF DISTENSION OF THE BLADDER UPON ITS POSITION.
a Anterior, and *b* Posterior, reflection of peritoneum. (*Fehleisen.*)

Fig. 436 shows the effect of strong distension of the bladder in an adult. The bladder assumes a spherical form, the prostatic urethra becomes nearly horizontal, and the prevesical fold of peritoneum is raised 2 cm. above the symphysis pubis. It may be noted that in another case less forcible distension might raise the reflection of the peritoneum more than in the experiment quoted. It is not safe to employ forcible injection of fluid, since this has led in some cases to rupture of the bladder. In the case of a child, about four to six ounces, in an adult

from ten to twelve may be taken as an average amount to employ. The bladder should be slowly filled, and the surgeon should estimate the distension by his hand placed above the pubes.

Preparation of the Patient.—The preparation, such as it is, has already been alluded to in the chapter on Lateral Lithotomy. If the bladder be unduly irritable, it is recommended that it should be washed out daily for some few days beforehand. The rectum must be well emptied. In the adult the pubes should be shaved. In any case, the region of the operation must be thoroughly cleansed.

By means of the X-rays it is easy to have determined the exact size of the stone before operation. If more than one calculus be present the radiograph will have shown this to be the case.

The patient lies upon the back, close to the right edge of the table. The pelvis should be raised so that the intestines fall away from the bladder. A few sponges are wedged in against the perineum, to collect any blood or fluid which may run in that direction.

The surgeon stands to the patient's right, and the chief assistant takes his place upon the opposite side of the table.

Instruments Required.—A scalpel; probe-pointed bistoury; scissors; sharp hook, blunt hooks; dissecting, artery, and pressure forceps; broad rectangular retractors; wound retractors; sound; lithotomy forceps and scoop; drainage-tube for bladder; needles, sutures, ligatures, etc.

THE OPERATION.

Distension of the Bladder.—A soft catheter is passed, the urine is drawn off, and through the catheter the bladder is washed out with a warm boracic solution (half an ounce to the pint). This is more conveniently done with an irrigator than with a syringe. The bladder is now filled with a weak warm solution of boracic acid. In children from two to five years of age three to six ounces will probably suffice. In adults, eight to ten or twelve ounces may be introduced. The injection

should be carried out by means of an irrigator held a few feet above the level of the table. The fluid then enters the bladder with a more equable stream than when it is forced in by means of a syringe. The quantity of fluid required must be placed in the irrigator, and no more. If a piece of glass tubing be inserted in the irrigator tube close to the nozzle, the ease with which the fluid enters can be noted, as also the evidence of any backward pressure. The irrigator is detached, and a Wells's forceps or clip applied to the catheter prevents the fluid from escaping.

Opening of the Bladder.—An incision about three inches in length is made precisely in the median line immediately above the symphysis. The incision should be extended about half an inch actually over that process of bone. There is no linea alba below the umbilicus, and after dividing the skin and subcutaneous tissues, the surgeon may find muscular fibre lying across the line of the incision. If the interval between the muscles is not readily found, the knife should be carried directly through the muscle fibres themselves, the median line being strictly observed.

The wound must be a clean one, and any tearing of the parts with the fingers or forceps, or the handle of the scalpel, to seek for an intermuscular interval, is to be deprecated. When substantial and powerful muscles are met with, it may sometimes be advisable to divide the fibres transversely, to a slight extent, close to their attachment to the bone.

Any bleeding points are secured with pressure forceps. The transversalis fascia is reached, and is divided in the same precise manner in the median line.

The area of connective tissue overlying the summit of the bladder is now exposed. This must be cleanly and precisely divided with the scalpel, and the bladder reached by dissection.

The peritoneum may possibly be made out, and can be readily pushed upwards with the left forefinger. The dissection necessary to expose the bladder should be commenced close to the symphysis, and be continued cautiously upwards. The peritoneum has been found adherent over the symphysis, and has been wounded. If such an accident should occur,

the opening should be at once closed by fine catgut sutures. The safest course under such circumstances will be to defer completion of the operation for a few days until the peritoneum has healed. Particular caution must be exercised if a previous suprapubic cystotomy has been performed on the patient. In one such case (a second large calculus formed in a child) I (J. H.) found the peritoneal reflection dragged down by the scar, but was able to avoid injury to it by working behind the pubis.

Wide rectangular metal retractors must now be used in order to extend the width of the wound to the utmost.

All bleeding into the lax connective tissue which is exposed must be arrested.

Several veins are met with ramifying over the apex of the bladder. They must be avoided. Should any be divided, the hæmorrhage may be free; but it will cease when the bladder is opened.

The prevesical fat may be considerable in quantity. It should never be torn through with the fingers or with the forceps and the handle of a scalpel. All such rough manipulations open the way for urinary infiltration. The exposure of the bladder should be, as already stated, by dissection.

All bleeding at this stage should be promptly checked, since the blood readily infiltrates the loose tissue in which the surgeon is working.

The bladder is recognised by its pinkish colour, by its rounded outline, and by the exposed layer of muscular fibres. The peritoneum, if in view, must be pushed upwards with the left forefinger, while the surgeon transfixes the bladder with a sharp hook. This hook should be introduced transversely across the median line, and should be inserted near the upper part of the exposed viscus.

The scalpel is now thrust vertically into the bladder, exactly in the median line and just below the hook, and is made to incise the organ by cutting downwards towards the symphysis. It should be introduced with a sharp stab, lest the undivided mucous membrane be pushed inwards by its point.

The actual opening of the bladder is demonstrated by the escape of the contained fluid. The hold upon the tenaculum

should not be relaxed. The cut margin of the bladder on either side of the opening should now be seized neatly and symmetrically with pressure forceps. These enable the operator to maintain a hold upon the organ during the remainder of the operation, and they render the position of the opening perfectly distinct.

Very little tissue need be taken up in the blades, and it has not been shown that the temporary compression of the instruments does any harm.

When the forceps are in place, but not before, the tenaculum may be removed.

When the bladder collapses, the fold of peritoneum may present at the upper angle of the wound. The tenaculum keeps it out of the way, but it may be noted that the membrane has been inadvertently injured at this stage.

Unless means such as have been described are taken to prevent the sinking of the bladder, its anterior wall may descend into the pelvis, and much damage may be done to the soft parts in endeavouring to draw it up again. The finger should not be prematurely thrust into the opening, and should never be introduced until the margins of the orifice have been fixed. Ill-considered attempts in this direction may cause the bladder to be pushed before the finger, the opening to be closed, and the viscus to be separated from the surface of the pubes.

The hæmorrhage from the edges of the wound in the bladder may be a little free at first, but it soon ceases.

As soon as the bladder has been opened, an assistant may remove the soft catheter.

The surgeon holds the right-hand pair of retaining forceps, while the assistant holds the left; and with the opening thus fixed, the right forefinger is introduced into the bladder.

The opening may be enlarged with a blunt-pointed bistoury as required. There is no need to make the orifice so small that the finger has to be wormed in.

The stone is now extracted. For this purpose lithotomy forceps may be used, or the scoop may be found to be of greater service, or the two forefingers may be employed forceps-wise.

Should any *débris* remain, or should the urine be putrid, the bladder should be well washed out.

In a perfectly straightforward case this may be dispensed with. Before the operation is concluded, the interior of the bladder should be thoroughly explored with the finger. The retaining forceps are removed from the bladder.

Two or three sutures of silkworm gut are introduced into the upper part of the parietal wound, each suture including the whole thickness of the divided tissues.

The question of suture of the bladder and total closure of the surface wound is considered in the next section.

Suturing of the Bladder.—This is an ideal method of concluding the operation whenever it can be carried out. The bladder wound should be closed by suture in children, and in healthy adults provided that the viscus itself is normal.

It is not wise to attempt it in aged subjects, in those who have cystitis, or in cases where the operation has been protracted, and the margins of the bladder wound are much bruised, as in the extraction of a large calculus.

The application of the sutures is comparatively easy in children and in thin adults. It is difficult in the corpulent.

The opening into the bladder is fixed, and is held up by two blunt hooks, one inserted at each extremity of the wound. By means of these hooks the margins of the incision are kept steady and parallel with one another. Fine catgut or kangaroo tendon should be employed. The sutures should be interrupted, and should be in two rows or layers. The deeper series should include the mucous membrane. The surface layer should include the other coats. All sutures should be introduced by means of a curved needle in a holder, and be very closely applied.

A small gauze drain is introduced into the lower part of the parietal wound, which is then closed.

A dry dressing is applied. The drain may be removed in forty-eight hours. Sometimes, however, leakage occurs after a few days, and drainage must be provided for.

The bladder is left undisturbed. No catheter is tied in, nor is any drain through the perineum necessary. If the

patient cannot pass water, a soft catheter must be introduced as often as required.

After-treatment.—If the wound in the bladder has been closed by sutures, the after-treatment of the case is conducted upon the lines observed after any ordinary abdominal section.

The question of the employment of the catheter has already been alluded to. The superficial sutures may be removed at the end of a week; and if all goes well, the patient may be sitting up in ten days.

If the wound in the bladder has been left open, the after-treatment becomes very tedious, and demands infinite care. The bed must be protected by macintosh sheets, placed beneath the usual draw-sheets. A large cradle is spread across the pelvis. The care of the wound will demand the constant and undivided attention of a nurse.

The skin of the perineum, buttocks, and lower part of the abdomen should be kept as dry as possible, and should be smeared with vaseline to prevent the irritating effects of the contact of urine. Over the wound should be placed a large sponge, and above the sponge should be a large pad of absorbent wool, applied transversely, like a scarf, from one side of the groin to the other.

This pad rests upon the pubes. It keeps the sponge in place, and serves to absorb any urine which may escape the sponge. It may be conveniently replaced by pads of cyanide gauze, frequently changed.

Not less than twenty sponges should be in use.

The arrangement of the bed-clothes over the cradle allows the part to be always in view, the patient's trunk and limbs being well covered up with blankets.

The sponges and wool pad must be changed as often as needed—possibly two, three, or four times in the hour. The pad is of course thrown away, but the sponge can be used over and over again. Each sponge is well rinsed in water, is then immersed for some hours in carbolic lotion, is once more rinsed, and is then dried ready for use.

Before each sponge and scarf of wool are applied, the skin should be rapidly dried. No bandage is required. The patient

must lie upon the back, and should assume, as soon as he is able, the sitting position. If he wishes to lie upon one or other side, the sponge and the wool pad must be adjusted to meet the altered position.

If this plan be carried out by intelligent and painstaking nurses, the patient's bed may be kept absolutely dry, and the skin perfectly sound and free from excoriation. The sponges can be changed during sleep without waking the patient, the wound being always in view through a "window" in the cradle.

The sooner the patient can sit up in bed the better, as the wound is much more readily dealt with when that attitude is assumed.

Any "dressing" secured with a bandage round the body is useless. By the time the dressing has been applied and the bandage secured, the whole arrangement is probably soaked with urine.

The bladder may, when necessary, be washed out with a boracic acid solution as often as occasion arises.

The bladder wound usually closes in two, three, or four weeks, and the external wound one or two weeks later. It is probable that the patient will be able to be moved into a chair by the end of the second or commencement of the third week.

Results of Lithotomy Operations.—The late Mr. Cadge gave in Heath's "Dictionary of Surgery" the results of the operations for stone performed at the Norwich Hospital.

The following is an abstract of a collection of 1,124 cases of lithotomy:—

Mortality, males	..	..	..	..	..	13½ per cent.
" females	..	..	..	..	..	8 "
Mortality under 20 years of age..	..	..	..	..	..	8 "
" over "	..	..	..	..	..	19 "
" " 50	..	..	..	..	..	27·4 "

Out of 1,030 patients, only forty were subjected to a second operation, and five to a third.

CHAPTER IV.

LITHOTRITY AND LITHOLAPAXY.

THESE operations concern the treatment of stone by crushing.

By *lithotrity* is understood the crushing of the stone by many repeated brief sittings, the fragments being left to be voided by natural means. The crushings are conducted without an anæsthetic. *Litholapaxy* concerns the entire crushing of the stone and the fragments at one sitting under an anæsthetic, the *débris* being completely removed at the time by means of a special instrument.

The latter and more modern operation has completely replaced the older procedure.

History.—The treatment of stone by crushing is of quite recent origin. Gruithuisen (a Bavarian surgeon) proposed in 1813 that the stone should be broken up by drilling, and invented some remarkable instruments, including a trephine, which do not appear, however, to have been employed on the living subject. In 1818 Civiale published an account of a litho-tripteur, but the instrument was never employed. A like fate attended the curved file introduced by Elderton (a Scottish surgeon) in 1819. During the next few years a great number of remarkable instruments were invented, including the saw, or lithoprione, of Leroy D'Étiolles, the brise-pierce of Amussat, and the brise-coque of Heurteloup. To a Danish surgeon, Jacobson, is due the credit of demonstrating in 1831 that stones might be crushed by simple pressure. Civiale's first successful operations had been performed already in 1824, but with very imperfect instruments. The development of the modern lithotrite followed very rapidly, and is associated with the names of Weiss, Heurteloup, L'Estrange, Brodie, Charrière, Thompson, and others. To Brodie, Coulson, and Sir Henry Thompson are mainly due the final elaboration of the operation, and its ready establishment in Great Britain. The experience of certain operators in India—such as Surgeon-Majors Keegan and Freyer—with regard to lithotrity

has been almost unrivalled, and they have done much to extend the scope of the operation, so that it is now performed on all patients with vesical stone, practically without limit as to age.

No description of the perfected instrument is called for. It is the outcome of innumerable experiments and of infinite ingenuity, and as an example of applied mechanics is without an equal in the surgeon's armamentarium.

In 1878 Professor Bigelow proposed the method of lithotripsy with which his name is associated, and to which he gave the title of litholapaxy. The ground had been prepared by the researches of Otis, who had demonstrated that the urethra could take with safety instruments of infinitely larger calibre than had ever been supposed. The way was thus made clear for the employment of large evacuating catheters, by means of which all *débris* could be removed. The use of anæsthetics, and the demonstration of the tolerance of bladder and urethra of the long-continued contact of instruments, completed the bases for the operation.

LITHOLAPAXY.

In the following account the more modern method of dealing with the stone—viz. by litholapaxy—will be dealt with. The brief notice of the older operation which stood at the end of the present chapter in the former edition has now been omitted.

Preparation of the Patient.—In an ordinary case no special preparation is needed. It is well, however, that for some days before the operation the patient should rest quietly in bed, and should sleep well. His diet should be simple and non-stimulating, and the action of the bowels should be attended to. The urine should, of course, be examined, and if found alkaline or containing pus, an attempt should be made to render it acid and aseptic by the administration of urotropine, etc. It is, however, often impossible to cure the cystitis until its existing cause, the stone, be removed. It is assumed that the urethra is in a condition to admit a sufficiently large lithotrite and evacuating catheter. There is no need that the bladder should be injected with fluid before the operation. The patient should not empty the viscus; and if three or four ounces of urine be retained at the time of the operation, so much the better.

The patient should lie flat upon the back upon the operating-table, and close to the right-hand edge. The pelvis should be raised above the level of the shoulders by means of a firm pillow. This has the effect of causing the stone to gravitate towards the fundus of the bladder.

The surgeon stands to the patient's right. The assistant takes up his position upon the opposite side of the table, and attends to the filling and adjusting of the evacuating apparatus. The thighs should be so separated that there is an interval of a foot or more between the knees. The patient is anæsthetised.

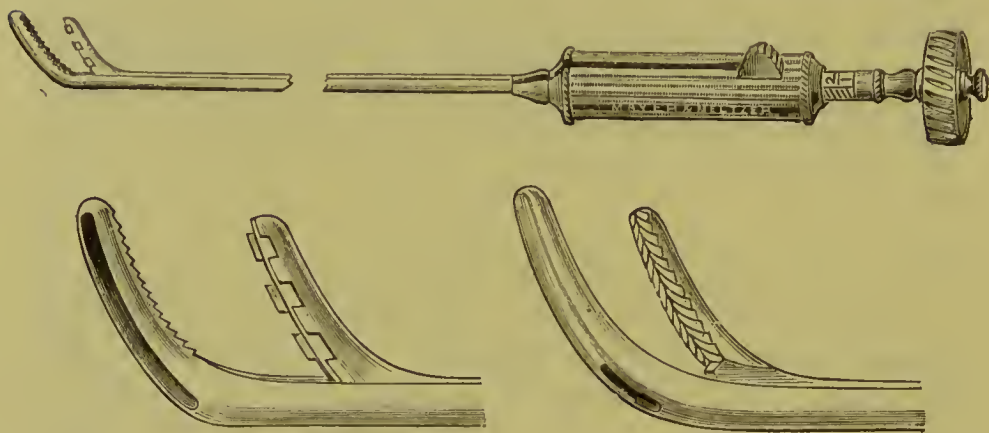


Fig. 437.—LITHOTRITE.

(The lower cuts show fenestrated and non-fenestrated blades.)

In suitable cases the operation may even be performed without an anæsthetic. If any doubt exists as to the capacity of the urethra, a sound of suitable size may be passed. In some instances it may be necessary to incise the meatus.

Before using the lithotrite the surgeon should have made himself thoroughly familiar with the instrument, and should have practised crushing operations with it outside the body.

Bigelow's form of lithotrite and evacuator (Weiss) are strongly recommended. They should be fully fenestrated, though it is advisable to have one non-fenestrated for occasional use. The lithotrites must be of the best tempered steel, and their crushing power tested before the operation. The smallest size (for children) is about No. 6 (English scale), the largest (for adults), No. 18.

The Operation.—No better account of the manipulations

involved in lithotrity can be given than is provided in the description by Sir Henry Thompson. The account appended is derived from Holmes's "*System of Surgery*," third edition, vol. iii., page 294:—

"The operator places himself on the right side of the patient, and stands with his back turned partly towards the head of the couch, his left side being to the patient's right. Having well oiled the lithotrite, he holds it lightly with his right hand, in a horizontal position, the blades pointing downwards, and raises the penis with his left; and as he introduces the blades into the urethra, the left draws the penis gently over the angular end of the instrument, which descends in this manner down to the bulbous portion of the urethra, the shaft rising gradually towards the perpendicular. Having arrived there, it is not now to be depressed as in catheterism, since this movement raises the point of the blades against the roof of the urethra in front of the deep fascia above the narrow orifice of the membranous portion, while the large capacity of the bulbous urethra favours the malposition described, and, if force is used to overcome the difficulty, laceration will probably take place. . . . In order to pass the blades easily and safely through the narrow membranous portion, it is necessary to maintain the lithotrite a few seconds at or near the perpendicular, permitting it to progress slowly in that position. This proceeding is accomplished by permitting a part of the weight of the instrument to act as the propelling power, while the penis is drawn upwards a little in the same—that is, the vertical—direction. In this position the blades slide through the bulbous portion, enter and traverse the membranous portion, and arrive at the prostate. Then, and not before, the operator gradually depresses the instrument towards the patient's thighs; the blades rise up through the prostatic portion into the bladder—a movement which is rendered more easy if a very slight lateral rotary motion is given to the instrument at this part of its progress. In ordinary—that is, normal—conditions the shaft of the lithotrite at the entry into the bladder forms an oblique line, and an angle of about twenty to thirty degrees with the horizon; and this it continues, as it

slides easily and freely down upon the trigone to the posterior wall of the viscus. It will be obvious that the urethra now entirely loses its curve, being occupied throughout by the straight shaft of the lithotrite. The jaws being now closed, and lying at the bottom of the cavity, or nearly so, the finding and seizing of the stone have to be achieved. . . .

“First, nothing is more important at the onset to remember than this—namely, that quiet and slow movements of the jaws of the lithotrite in searching the bladder are desirable, because rapid movements produce currents in the urine, which keep the stone more or less in motion, so that it is less easily seized than when the surrounding fluid is in a state of rest. . . .

“Let it be understood that the blades of the lithotrite have entered the cavity of the bladder, and that the instrument slides easily and smoothly down the trigone, which in the living and healthy organ is an inclined plane, although quite otherwise in the atonied and in the dead bladder. In many cases the instrument in thus passing grazes the stone, and the slightest lateral movement of the blades, right or left, will determine on which side it lies. Whether the stone is felt or not, when the blades have passed gently down in the middle line until a very slight check to their movement is perceived, the lithotrite should rest there for three or four seconds, and then the male blade should be slowly withdrawn, without moving any other part of the instrument, towards the neck of the bladder, until a very slight check is perceived in that direction, followed by another three or four seconds' rest, for currents to subside. Now the operator should quietly press back the male blade, without changing the position of the lithotrite, and almost certainly the stone will be seized. In other words: open; pause; close—that is all. It is necessary always to remember, when withdrawing the male blade, that it is never to be drawn out roughly, since in this action the sensitive neck of the bladder may easily be irritated.

“But if no stone is thus found, the operator again withdraws the male blade as before, but inclining to the right side about 45° , and closes without disturbing the central position of the instrument; if nothing is felt, he turns to the left in

like manner, and closes. It is often right to open the blades before turning, for this reason: if the turn is first made and the blades are subsequently opened, the male blade as it is withdrawn will often move the stone away; whereas if the blades are inclined while open, the stone, if there, is almost certainly seized. It is not very common for the stone to elude the search thus far; but if it does, depress the handle of the lithotrite an inch or so, an act which raises the blades slightly from the floor of the bladder, and turn them another 45° to the left—bringing, in fact, the blades horizontal to the left; close; if unsuccessful, turn them gently to the horizontal on the right, and close. In all these movements, if properly executed, there has been barely contact of the lithotrite with the vesical walls: at all events no pressure, nothing to occasion injury to the bladder. But if there is an enlarged prostate, causing an eminence at the neck of the bladder, or the stone is very small, or we are exploring for some fragment suspected to be present, the blades are to be reversed so as to point downwards to the floor, and the object sought may then often be secured with ease. If seeking for a small stone or for fragments, we may employ a lithotrite with short blades, which can therefore be reversed with greater ease than one with long blades.

“In order to do this properly, the handle of the lithotrite is depressed another inch or more between the patient’s thighs, so that the shaft of the instrument, instead of being directed a little upwards, is level with, or points below, the horizon; the blades, being still closed, are cautiously brought round to the reversed position, and the floor first lightly swept, in the manner of a sound in searching for stone. Then they may be carefully opened and closed two or three times, in slightly varied directions, but without injuring the floor of the bladder; after which an exhaustive examination of its cavity ought to have been accomplished. It sometimes happens, when the prostate is considerably enlarged, and a stone or fragments have to be sought behind it, that the lithotrite can be reversed without depressing the handle.

“As a rule, all these movements are to be executed at or beyond the centre of the vesical cavity, the proper area for

operating, without hurry, rapid movement, or any other which partakes of the nature of a jerk or concussion. The most common cause of failure to seize a large stone arises from its close proximity to the neck of the bladder (whatever position is given to the patient), and from the male blade being drawn up against it at each opening of the lithotrite. In these circumstances, the operator feels the contact of the stone, without suspecting its precise locality, each time he withdraws the blade, and is apt to feel embarrassed on failing to seize it when he closes immediately after. In these cases it is essential to draw the male blade gently, but closely, to the neck of the bladder, and to slide the blade between the neck and the stone which lies in contact with it.

“The rules already laid down for finding and seizing apply more or less to lithotrites of moderate size, but this general rule may be borne in mind: viz. the more powerful the lithotrite—that is, the larger and longer are its blades—the less readily are we to adopt the reversed positions of the blades, and the more fluid is it desirable to have in the bladder. As large and fenestrated blades are used chiefly for the initial act of breaking up a large stone into fragments, it is obvious also that there is less occasion for the horizontal and reversed movements, since a large stone may almost certainly be seized by the right or left incline.

“Now, supposing that a hard stone of an inch and a half in diameter has fallen into the grasp of a powerful lithotrite, the screw is to be gradually turned at first, to make the blades bite, since a sharp turn at this moment may drive the stone out either right or left. As the power is increased, the resistance is felt to relax, sometimes by degrees, sometimes suddenly with a crack, and the stone is broken—usually into four or five large pieces, besides some small *debris*. This done, the male blade is again drawn out, taking care not to shift the situation or alter the axis of the lithotrite, and, almost certainly, one of the large fragments will be picked up. It is then only necessary to screw home, release the screw, and open as before. This process may be repeated several times at the same spot, for the area within which the larger fragments

fall is very limited, and is unchanged if all remains quiet. . . .

“Having now broken up the stone, and crushed well the largest fragments, and thus occupied perhaps from ten to fifteen minutes, it should be time to employ the aspirator, and remove a good quantity of *débris*. Accordingly, the screw of the lithotrite is driven well home, to close the blades, between

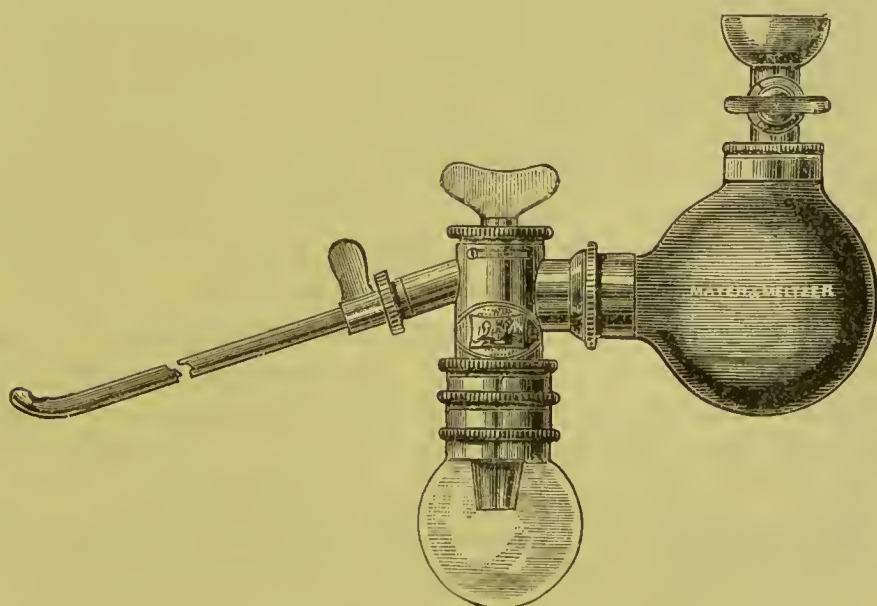


Fig. 438.—EVACUATOR FITTED TO CATHETER.

The glass globe and rubber aspirator are both filled with warm boracic solution.
The two taps are turned ready for use.

which some calculous matter probably is engaged, and the lithotrite is withdrawn. An evacuating catheter of the size known to be necessary—No. 15 or 16 amply suffices for small stones; No. 17 or 18 may be employed for larger ones, if the urethra fairly admits it—is then introduced, and all the urine withdrawn. An aspirator previously filled (with a warm boracic solution) is then attached, the connection-tap opened, and a small portion of its contents pressed by the right hand into the bladder, the left hand supporting and directing the evacuating catheter. On relaxing the pressure, an immediate current outward follows, carrying with it very probably a fair quantity of *débris*. Wait some three or four seconds after

expansion has finished, and the current apparently ceased, as at that precise time it is quite common for one or two of the large fragments to drop into the receiver, which would have been driven back perhaps by too rapidly resuming the pressure. This process is repeated several times, according to the amount of *débris* observed to enter the trap.

“ If the patient is breathing heavily under the influence of ether, it is desirable to inject during the act of his expiration, and let the fluid flow outwards into the aspirator during his inspiration, which act assists the evacuation of the bladder.

“ After a large crushing, the end of the evacuating catheter should not rest on the floor of the bladder, as it is then likely to be choked with *débris*. But after most of the fragments have been removed, it is advantageous to lower the end of the catheter, in order to catch the last fragments.

“ If the outflow of the current is felt to be suddenly checked, and the aspirator ceases to distend, the operator may be almost certain that a fragment of a rounded or cubical form, or a small calculus, nearly fitting the interior of the catheter, blocks the passage and prevents further egress. The piece must be expelled by making smart pressure on the indiarubber bottle, after which the action of the aspirator will probably be resumed.

“ If after crushing all the stone, so far as the operator is able to judge, and removing the *débris* largely, nothing is heard or felt in contact with the end of the evacuating catheters, notwithstanding that three or four successive pressures have been made, there is ground for believing that all the fragments may now have been removed. Perhaps there can be no better proof that the bladder has been emptied than is afforded by the fact that a succession of outward and inward currents through the aspirator shows no sign, either to the eye or to the ear, of the presence of another fragment.

“ It may be added here that evacuating catheters of different patterns should be within reach. The curve, the situation of the opening, may vary advantageously in different cases; the latter may be either terminal or lateral.

“ If all has not been removed, the sound of a large piece perhaps making itself heard and felt at each outward current

against the end of the catheter indicates that this must be withdrawn, and a lithotrite introduced. If the fragments are not of considerable size, a lighter and handier lithotrite may succeed with advantage to the heavy fenestrated one originally used, and the crushing continued. Of course, if more stone remains, the process is repeated once or more."

The following practical observations by Dr. Keyes may find a place here:—As the tube is moved from side to side, and particularly when the curved tube is inverted, the bladder wall often flaps with a sharp click against the eye of the tube, and then flutters spasmodically with dull thuds against the open end of the instrument. When the bladder is empty, the sharp click may be so hard in quality as to resemble the sound given by a fragment of some size.

Should air enter the bladder, it churns up the water, distends the bladder, interferes with the efficient washing-out of the viscus and with the recognition of small fragments. To dislodge the air, the bladder should be fully distended, and then the handle of the tube be fully depressed between the thighs, so that the open end may be raised to the top of the bladder. The evacuator is now worked slowly, the air escapes into the bottle, and, remaining at the top, can be allowed to escape.

Time Occupied by the Operation. — From twenty to forty or seventy minutes will suffice for all ordinary cases. In one instance Bigelow operated continuously for upwards of three hours. The stone weighed 744 grains. The patient did well. Freyer observes:—"The amount of manual labour required for dealing with large calculi is excessive. My hands were often blistered, and arms frequently ached for days after performing litholapaxy in one of these cases." During a protracted crushing it is important to guard the patient against chill.

Complications.—As a rule, the bleeding is trifling or absent. It may, however, be severe, and depend upon damage to the urethra, bladder, or prostate, or be due to the presence of a vesical growth. It is therefore a serious sign.

Complete elogging of the instrument with *débris* has occurred. This is only possible with the non-fenestrated lithotrite.

If the blades cannot be cleared, nor the instrument removed, it must be cut down upon from the perineum, and when cleared, must be withdrawn. The operation is then completed as a perineal lithotomy.

After-treatment.—The patient must lie in bed. An india-rubber hot-water bottle or a warm fomentation may be applied to the hypogastrium. Some opium may be required.

There may be some urethral fever, or retention of urine from atony of the bladder. Sir Henry Thompson points out that a little subacute cystitis not unfrequently appears on the fourth or fifth day. The administration of urotropine or cystamine in five-grain doses and the injection into the bladder of a few ounces of solution of nitrate of silver (half to one grain to the ounce) are useful for this complication. The patient should be kept on a light or milk diet, and remain in bed until any cystitis has subsided. If the stone is small and there have been renal symptoms, the opportunity should be taken to exclude the existence of other calculi in either kidney by skia-graphy. A warm hip bath daily adds greatly to the patient's comfort. The urine contains no trace of blood as a rule after the second to the fourth day; and in the majority of cases the patient may be allowed to get up on the seventh day. An occasional and troublesome complication, met with especially in adults, is orchitis or epididymitis.

According to Dr. Freyer (*Brit. Med. Journ.*, May 9, 1891), the average number of days spent in hospital or under treatment is, in adult males, six; in boys, five and a half; and in females, four.

Results of Litholapaxy.—Sir Henry Thompson's cases of lithotrity since 1878 number 378, including 325 treated at one sitting. The mortality is a little over $3\frac{1}{2}$ per cent. (*Med.-Chir. Trans.*, 1890).

Dr. Keegan, in 160 lithotrity operations upon male children, had a mortality of only 4.37 per cent. (*Lancet*, October 4, 1890).

Dr. Freyer reports 598 litholapaxies—426 in male adults, 13 in female adults, 158 in male children, 1 in a female child. Out of this large number there were only eleven deaths (about 2 per cent.)

Mr. Cadge expressed his belief that the relapses after simple lithotrity reached to nearly 20 per cent., if the cases of phosphatic deposits and concretions common after this operation are included among the examples of recurrence of the stone. Litholapaxy is attended with no such proportion of unsatisfactory results; and, indeed, if the evacuator be carefully and thoroughly employed, the relapses after litholapaxy will probably include no cases of recurrence due to the actual retention and subsequent increase of a fragment.

LITHOLAPAXY IN MALE CHILDREN.

Lithotrity and litholapaxy have been condemned as unsuited for the treatment of stone in male children upon the following grounds:—(1) The smallness of the bladder; (2) the delicate character of the mucous membrane of the bladder and urethra, rendering it liable to laceration; (3) the small calibre of the urethra; and (4) the great success of lithotomy operations on children.

Dr. Keegan (*Indian Medical Gazette*, June and September, 1885) was the first to systematically demonstrate the fallacy of these objections, and in his hands it very soon became evident that litholapaxy offered an excellent means of treating stone in children.

(1) The bladder of a child, even if only two or three years of age, is large enough to allow of the manipulation of suitable lithotrites and evacuators. In Dr. Keegan's lists of cases will be found several successful instances of litholapaxy in children of three, two and a half, and two years of age. One child's age is given as one year and three-quarters. The stone weighed eighteen grains, and the child left the hospital in four days.

(2) The mucous membrane is certainly delicate, but it is exposed to no especial risk of laceration if due care be employed. Dr. Keegan very properly insists that no one should attempt to perform litholapaxy in boys until he has first gained some experience of the operation in male adults.

(3) The urethra in male children is of much greater calibre than was supposed. The meatus is often very small, and has to be incised. Dr. Keegan states that the urethra of a boy from three to six will admit a No. 7 or No. 8 lithotrite (English), and that of a boy from eight to ten will admit a No. 10, No. 11, or possibly even a No. 14.

In the actual performance of the operation the following points need special note :—

(a) The lithotrite must be completely fenestrated. For litholapaxy in boys Dr. Keegan advises a set of fenestrated lithotrites, running from No. 6 to No. 10. He states that with a No. 8 lithotrite and a No. 8 evacuating catheter it is quite possible to dispose of a mulberry calculus, weighing between 200 and 300 grains, in an hour's time.

(b) The evacuating catheter should be provided with a stylet, so that any fragment lodged in the eye may be displaced:

(c) The stone must be very thoroughly crushed, since the small size of the catheter will only allow comparatively fine fragments to pass. It is well that the first crushing should be as complete as possible, in order to avoid the unduly frequent passage of instruments.

The results of the operation in children are alluded to in the previous section (page 610).

CHOICE BETWEEN LITHOTOMY AND LITHOLAPAXY.

The **suprapubic operation** may be indicated under the following conditions :—

1. A large hard stone in the bladder—when, for instance, the long diameter exceeds one and a half inches. A soft calculus, largely composed of phosphates, may be safely crushed when much exceeding the above measurement (the exact size of any vesical calculus can always be ascertained beforehand by skiagraphy). It must be noted that the operator's experience with the lithotrite largely determines the size of the stone he may safely undertake to crush. The age of the patient is important. Lithotripsy may be tried on an adult with a stone

of a size for which a cutting operation would certainly be indicated in a young child.

2. Encysted calculi, whether fixed in a pouch behind a large prostate or in a diverticulum from the posterior wall, can only be dealt with by suprapubic incision. In the former case the prostatic obstruction should if possible be removed at the same time as the stones. When a pouch exists in the posterior wall of the bladder bulging towards the rectum, it is almost certain that calculi will re-form in it, and the operation will require to be repeated.

3. When a calculus has formed on a foreign body of such size and shape that its removal by the urethra is impossible.

Median lithotomy is indicated for calculi in the prostatic urethra or the prostate itself.

Lateral lithotomy can now be very rarely, if ever, required. Every case for which it would have been done in former days can be treated with less risk by an experienced lithotritist. At the same time, if a surgeon has had little or no practice with a lithotrite he may be wise to resort to a cutting operation.

CHAPTER V.

TREATMENT OF STONE IN WOMEN.

1. IN the case of quite small stones the urethra may be dilated, and the stone removed by suitable forceps.

The dilatation of the urethra is best accomplished by Hegar's uterine dilators while the patient is in lithotomy position and under an anæsthetic. The canal can soon be sufficiently dilated to admit the forefinger, the amount of laceration is reduced to a minimum, and the subsequent incontinence is of short duration. The process of dilatation should be slowly carried out, and each dilator be introduced gently.

2. In the case of larger stones, which could not be removed by the above method, the urethra should be dilated by Hegar's dilators until the canal will admit the forefinger; a lithotrite is then introduced, and the stone crushed at one sitting, the fragments being removed by a large evacuating catheter.

The comparatively large size to which the urethra may be dilated renders the operation of litholapaxy simple and efficacious. The pelvis should be well raised while the lithotrite is being used.

By this method stones up to the weight of one and a half or two ounces may be dealt with.

3. The largest vesical calculi—those weighing three or more ounces—should be dealt with by suprapubic lithotomy.

In no operation upon the adult female for the removal of stone is it necessary to incise the neck of the bladder.

Vaginal lithotomy has been replaced by litholapaxy and suprapubic lithotomy.

CHAPTER VI.

REMOVAL OF TUMOURS OF THE BLADDER.

WITHIN recent years certain cases of vesical tumour have been very successfully dealt with by operation, and many have been followed by complete cure. In instances in which the operation has been of necessity incomplete, or in which a rapid recurrence of the growth has supervened, considerable relief has usually been given to the patient, and the more distressing symptoms have been got rid of.

The method of treating vesical growths by deliberate operation was prominently brought before the notice of surgeons by Sir Henry Thompson, who in 1883 published an account of twelve cases so treated (*Med.-Chir. Trans.*, vol. lxvi., page 349).

Mr. E. Hurry Fenwick's monographs on the subject are worthy of perusal.

The suprapubic route alone gives proper access to the tumour and enables its removal to be accomplished under the eye of the surgeon. Hence this method is now advocated, the perineal route being entirely abandoned. If possible, the size and position of the tumour should have been previously ascertained by means of the cystoscope. Unfortunately the hæmaturia, which is the chief symptom of vesical growths, renders such examination difficult.

Special Instruments Required.—Thompson's tumour forceps; long curved or bent uterine scissors; vaginal specula of different sizes; vulsellum forceps; cautery; long sponge-holder forceps; sharp hook; electric head-lamp, which must give a powerful light.

The Operation.—The pelvis being raised, the bladder is gently distended with sterilised water introduced through a

rubber catheter. Through a median incision placed immediately above the pubes the bladder wall is exposed and incised with the aid of the sharp hook. The incision should be small, and the index finger should at once be introduced to examine the growth, to ascertain its exact point of attachment, its degree of firmness, and the width of its base. In three out of four cases both of innocent and malignant tumours the attachment will be found in the region of the trigone, on the



Fig. 439.—THOMPSON'S FORCEPS.

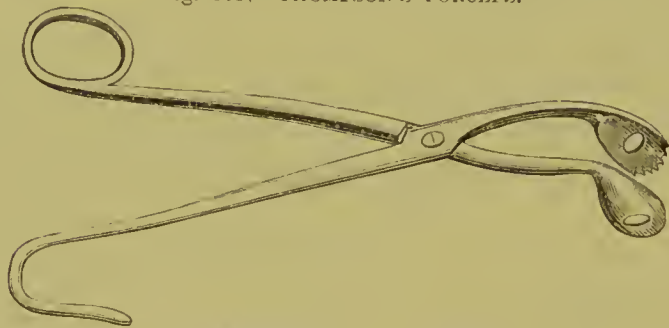


Fig. 440.—THOMPSON'S FORCEPS.

posterior wall. A soft villous growth may be at once detached and removed by the index finger. In more difficult cases it is necessary to introduce a speculum through the bladder wound, which should be enlarged with a bistoury for this purpose. The edges of the vesical wound are secured with two long silk sutures, which serve as retractors. A vaginal speculum is then introduced and all fluid mopped up with sponges. In many cases the tumour can be dealt with through the speculum, which has the advantage of preventing access of urine during the manipulation. If, however, the base of the tumour is too broad for this, other forms of the speculum may be employed.

Various instruments have been invented for the purpose of keeping the opening in the bladder sufficiently patent to allow

of a view of the interior being obtained. The speculum devised by Dr. Watson, of Boston, and described in the *Lancet* for October 18, 1890, is an ingenious instrument. In its general features it somewhat resembles an eye speculum. The blades are of strong wire, and are readily introduced. They can be accurately adjusted, and are self-retaining. They serve to separate and fix the margins of both the vesical and the abdominal wounds.

The speculum, being two-bladed, fails, however, to keep back the posterior wall of the bladder, and the same may be said of the two-bladed speculum of Keen's.

The most serviceable instrument of this class is the three-bladed speculum invented by Mr. Bruce Clarke, and described in the *British Medical Journal* for July 4, 1891.

The growth, when exposed and carefully examined by the finger, and also by inspection, may be dealt with in the same manner as like growths in more accessible parts would be treated. A small electric lamp is of considerable service. Growths with slender pedicles may be pinched or twisted off. If the pedicle be stouter, it may be grasped and fixed close to the bladder wall by means of a pair of pressure forceps bent at a suitable angle. The neck is then grasped by a straight pair of pressure forceps at a little distance from the first pair, and is twisted off by rotating the instrument last introduced.

If the growth have a broader base, it may, if it be well defined, be transfixed close to the bladder wall by means of a rectangular needle in a handle, and be then ligatured with silk in two segments. The best uterine scissors will be found useful.

Some of the softer and more diffused growths can be scraped away with the finger-nail, or with a curette or sharp spoon.

Others, of greater substance, can be removed piecemeal with Thompson's forceps (Figs. 439 and 440), and the resulting stump then well scraped with Volkmann's spoon. This is the method which would be applied to epitheliomatous growths.

After the removal of extensive growths the bladder may be well rubbed out with a Turkey sponge, which will remove all detached or partly-detached fragments.

Bleeding may be checked by the pressure of a firm piece of sponge, or by irrigation with iced water. The cases must be

few in which an appeal to the actual cautery is necessary. If the rectal bag is used its pressure causes venous engorgement, and the sooner the appliance can be dispensed with the better. Two fingers introduced into the rectum by an assistant will often bring the growth more readily into view than will the rectal bag.

The after-treatment of the case is the same as is observed after suprapubic lithotomy.

Growths of the Female Bladder can, in the great majority of instances, be dealt with through the urethra. The urethra is most conveniently dilated by means of Hegar's uterine dilators. The process is rather slow, but it is satisfactory, and leads to the minimum amount of laceration of the part. After sufficient dilatation the finger can be introduced, and the growth examined.

Pedunculated tumours have been dragged sufficiently far forwards to enable a ligature or the loop of an *écraseur* to be applied to their pedicles.

Other tumours may be torn or bitten off with forceps, while the softer and more diffused growths may be scraped.

Larger and multiple vesical tumours are better dealt with through a suprapubic incision.

The **results** of operations for the removal of vesical growths may be said to be on the whole distinctly satisfactory. The period has not yet been reached when any substantial value can attach to the publication of statistics.

Dr. Stein's table, published in 1885, gave the general mortality of all operations for vesical growths as 39·8. Since 1885 the aspect of the operation has been much altered, and the mortality has been greatly reduced.

It may be said that while a certain number of cases are entirely cured, a large number show a recurrence of the growth, but that even in the worst cases the operation affords the patient very substantial relief and prolongs life.

Resection of Portions of the Bladder.—This operation has been performed now and then in cases of malignant disease, but the results have at present not been sufficiently good to give the procedure a definite place in surgery.

CHAPTER VII.

OPERATIVE TREATMENT OF ENLARGED PROSTATE.

So long as a patient with enlarged prostate can live in comfort with the occasional use of a soft catheter, no operation is to be advised. But when catheterism becomes increasingly frequent and difficult the question of a radical operation has to be considered. Recent experience has shown that the risk of prostatectomy is much less than it was formerly considered to be; and, further, that the complete removal of the large adenomata which usually form the obstruction is attended by results with which those following partial excision cannot be compared.

Before describing the operation of prostatectomy, we have to note a number of alternative measures which have had a certain vogue of late years.

1. The division of a supposed prostatic bar by the galvano-cautery introduced through the urethra (Bottini's operation), though still advocated abroad by some surgeons, must be wholly condemned. It is a blind and dangerous method, from which no permanent relief can be expected. The same may be said of "tunnelling the prostate."
2. Ligature of the internal iliac vessels in order to induce atrophy of the gland has been tried repeatedly with no success.
3. Excision of one or both testes, or the more trivial operation of "vasectomy" (ligature and division of both vasa deferentia), performed with the same idea of inducing atrophy, has a literature out of all proportion to the benefit derived from such methods. It

may, indeed, be said that both operations are now practically abandoned.

4. Permanent drainage of the bladder above the pubes (or by the less suitable perineal route) is only a palliative measure. It substitutes one grave inconvenience for another, and it can be so rarely indicated that no description of the measure is here required.

The patient with prostatic obstruction has therefore the two alternatives before him of regular catheterism or of prostatectomy.

History of the Operation.—The late Mr. McGill of Leeds was the pioneer of suprapubic prostatectomy. He advocated strongly that the bladder should be opened above the os pubis in preference to approaching it from the perineum. How closely the modern operation follows the lines laid down by McGill will be seen by the following quotation (given in the first edition of this work) from the *Lancet*, February 4, 1888 :—

“The prostate should be removed as far as possible by enucleation with the finger, and not by cutting. The mucous membrane over the projecting portion having been snipped through, the rest of the operation is completed with finger and forceps. In this way excessive hæmorrhage is prevented. Hæmorrhage is best arrested by irrigation with water so hot as to make it unpleasant for the hand.”

It is well to emphasise the fact that to McGill is due the sole credit of originating the operation, and that many surgeons following his teaching have since performed complete removal of the hypertrophied part of the prostate with success. As Mr. Mayo Robson writes (*Brit. Med. Journ.*, September, 1902) :—

“Prostatectomy for the relief of urinary obstruction is an operation that was unknown before 1886 ; it owes its origin to our late and much-lamented colleague, McGill, whose name and reputation as a surgical genius add lustre to the Leeds School, and, in fact, to British surgery. He not only originated the operation, but improved and perfected it, and those members of the profession who attended the meeting of the British Medical Association in Leeds in 1889 will remember with what natural pride he showed a number of aged patients in good health on whom the operation had been done.”

It must, however, be noted that of the twenty-four cases then reported by McGill, Atkinson and others, the operation had proved fatal in four (nearly 20 per cent.), and that only seven of the twenty remaining were able to dispense entirely with the use of a catheter. To Mr. P. J. Freyer we owe the advocacy and general adoption of

enucleation of the entire prostate in preference to the use of cutting instruments, or of partial prostatectomy. Mr. Freyer's description and narration of his cases (forty-five in all) will be found in the *Brit. Med. Journ.*, July 20, 1901; February 1, July 26, and November 8, 1902; April 18 and July 4, 1903.

Many surgeons took part in the controversy which followed these papers, two main questions being debated—first, whether it was possible to enucleate the entire prostate “in its capsule”; secondly, whether Mr. Freyer's was a new form of operation. The whole subject is ably discussed and summarised in two interesting papers by Mr. Southam and Sir William Thomson (*Brit. Med. Journ.*, April 18, 1903).

Anatomical and other Considerations.—As seen in Fig. 441, the prostate is composed of two lateral lobes, separated

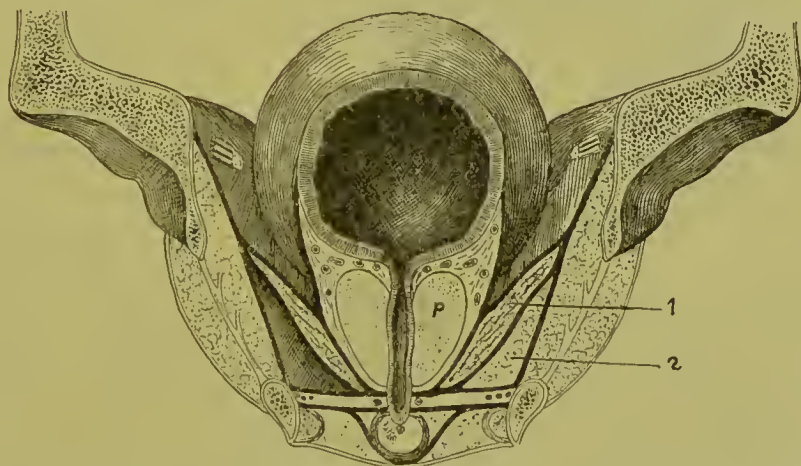


Fig. 441.—SECTION THROUGH THE PROSTATIC URETHRA TO SHOW THE RELATIONS OF THE PROSTATE GLAND (P) TO ITS FASCIAL INVESTMENT, ETC. (*After Testut.*)

1, Levator ani, enclosed between two layers of fascia, the inner one forming the true sheath of the prostate; 2, Ischio-rectal fossa. The capsule which closely adheres to the prostate is shown as a thin line, outside which are many veins cut across.

only in part by the urethral canal. The so-called middle lobe would appear to be in most, if not all, cases a projection upwards behind the vesical orifice from one or other lateral lobe; it is always a pathological product. The apex of the prostate rests on the triangular ligament; the base or upper end is closely connected with the sphincter of the bladder.

The prostate is encased in a fibrous capsule which sends in processes amongst the glandular masses of which the organ is largely composed. These septa of fibrous tissue are rein-

foreed by much unstriped museular tissue and blood-vessels. How much of the normal prostate is glandular will be seen from Fig. 442.

Immediately outside this fibrous sheath of the prostate is a plexus of veins and then the reeto-vesical sheath of fascia, which forms an outer investment of the prostate and separates it from the levator ani, the reetum, and the os pubis. It is important to note that when removal of the entire prostate

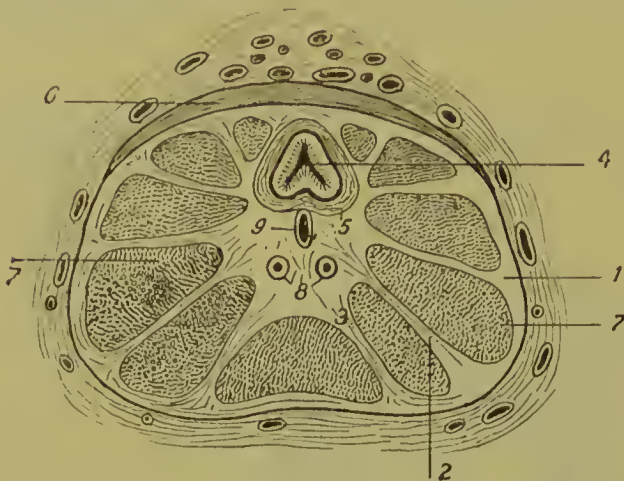


Fig. 442.—SECTION THROUGH THE PROSTATE GLAND.
(After Testut.)

- 1, Fibrous tissue and unstriped muscle forming a capsule and sending in (2) septa between (7) the lobules of glandular structure; 6, transverse muscle band belonging to the vesical sphincter; 8, common ejaculatory ducts; 3, central area of connective tissue; 4, prostatic urethra (mucous coat); 5, circular muscle of urethra; 9, sinus, or utricle.

in its capsule is spoken of, the inner true capsule is meant, and not the reeto-vesical layer, which is prolonged upwards (eneasing the vesiculæ seminales) on to the reetum and bladder. The venous plexus alluded to is particularly well developed in front of the prostate (Fig. 442), between it and the os

pubis, as well as around the neck of the bladder. It is mainly from this plexus that the hæmorrhage occurs during and after prostatectomy.

It may be said that all *large* prostates are formed of adenomata, which are peculiarly suited for enucleation, as the adenomata separately or the entire gland converted into a mass of them can be readily shelled out with the fingers.

As the prostate enlarges, its projection is mainly upwards into the bladder, hence the extent to which it bulges towards the reetum is a very imperfect index to the total enlargement. Hence, also, enucleation from above the pubis is naturally easier than from the perineum. In many cases directly the

anterior wall of the bladder is incised the projecting mass comes into view.

The severity of the patient's symptoms or the degree of obstruction is not closely related to the size of the enlarged prostate. In some cases—fortunately the minority—the enlargement is mainly due to increase of fibrous and muscular tissue. Thus a dense and comparatively fixed prostate of no great size is produced.

Enucleation of such a gland is more difficult and dangerous than is that of the gland the seat of the common adenomatous hypertrophy. Should the surgeon after opening the bladder find that the prostate is very tough, and that attempts to enucleate it are attended with serious bleeding, he will do wisely to content himself with a partial prostatectomy, removing the direct obstruction at the neck of the bladder by means of cutting forceps.

The relation of the prostatic urethra to the enlarged organ is of importance. The urethra traverses the front part of the gland, and by careful enucleation on either side as well as from behind it is often possible to leave the canal intact. In many cases, however (Fig. 625), this portion of the urethra has been removed with the rest of the gland. The mucous membrane of the bladder will then ultimately become continuous with the membranous urethra at the triangular ligament. It is a surprising fact that no harm results from this removal of a considerable part of the urethra.

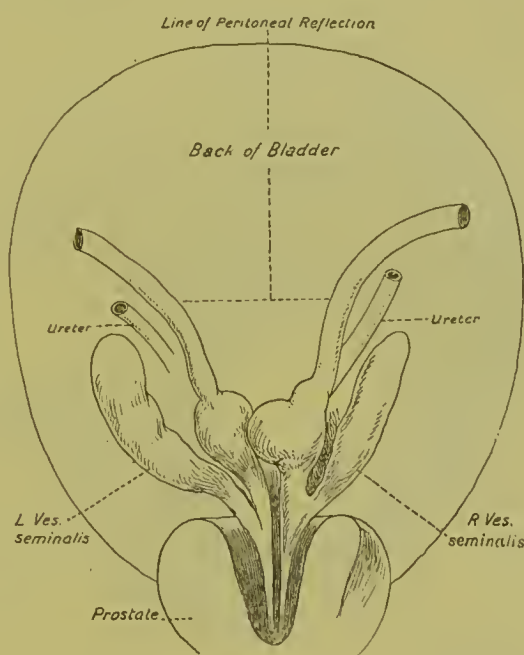


Fig. 443.—SKETCH SHOWING RELATION OF STRUCTURES IMMEDIATELY BEHIND THE BLADDER.

The prostate gland is incised to show the course of the common ejaculatory ducts.

The two common ejaculatory ducts pass obliquely through the prostate, lying side by side, and in enucleation of the gland they must of necessity be torn across. (Fig. 443.)

It is not infrequent for calculi in the bladder to complicate prostatic enlargement, and the suprapubic incision enables them to be readily removed before enucleating the gland. In one case Mr. P. J. Freyer extracted ninety-six calculi. The operator should aim at removing the obstructing mass down to the triangular ligament, though whether the entire gland is got away in all cases may be doubtful. It is certain that a thin layer of prostate, spread out around the main adenomatous tumour, is frequently left behind.

The age of the patient is no bar to operation. In most of the cases operated on the age has been from sixty to seventy years. In one case I (J. H.) removed the prostate from a patient eighty years old, and he regained normal control over the bladder.

It is, of course, desirable to diminish the shock by rapid operating and by guarding the patient against chill in every possible way. Theoretically the urine should be made aseptic beforehand, but this may be impossible in the presence of residual and decomposing urine which cannot be washed out.

Advanced kidney disease is the most serious danger of the operation.

Suprapubic Prostatectomy.—If a catheter can be introduced the urine should be drawn off when the patient is under the anæsthetic, and the bladder lightly distended with warm boracic solution. The hand placed on the hypogastrium will show when the distension is sufficient.

The pelvis should be somewhat raised. The incision—three inches long—should be made immediately above the pubes in the middle line. The recti being separated, the transversalis fascia is divided and the prevesical space opened up. The bladder wall is then clearly made out, and either a sharp hook or a silk suture inserted towards its upper end. The suture gives the better hold. A sharp pointed scalpel is then thrust through the anterior vesical wall. The opening should not be made close to the pubes, as there the upward projecting prostate

might be in the way. A couple of sutures should be inserted into each side of the bladder wound, so that it may be held forwards, and the escaping urine or fluid should be rapidly mopped up with sponges. The bladder is now explored with the fingers, and if calculi are found behind the prostate they should be at once removed. In most cases the enlargement will be found to be adenomatous with one or more intravesical projections. Guided by the left index finger an incision is made with knife or scissors through the mucous membrane covering either lateral projection. This can be easily enlarged with the finger, which indeed may be used to scrape through the mucous membrane itself, no cutting instrument being in such case employed.

The growth is then enucleated, working downwards and inwards to-

wards the triangular ligament on either side. Much assistance may be obtained by the surgeon's left fingers (or those of an assistant) in the rectum. If possible, the prostatic urethra should be separated from the gland and left, but in many cases it has to be removed at the same time. The hæmorrhage may be considerable, but no attempt at stopping it can be made until the growth has been removed from the bladder. In some of Mr. Freyer's cases the actual enucleation of the gland has only occupied from five to ten minutes. A sponge wrung out of hot water should then be introduced and pressed down

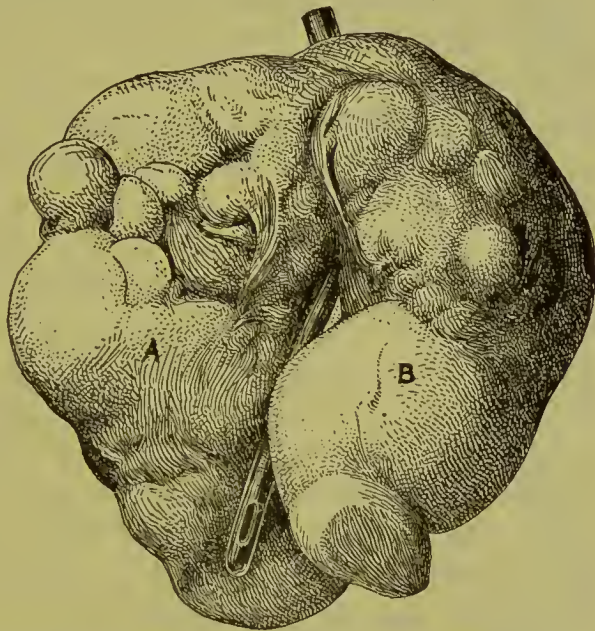


Fig. 444.—PROSTATE WEIGHING $6\frac{1}{2}$ OZ. REMOVED FROM PATIENT AGED 68.

A B, Lateral lobes; bladder end of B shows an ulcer caused by calculi, the catheter placed in course of the urethra showing its tortuous shape. (From one of Mr. P. J. Freyer's cases.)

on the bleeding area. It is possible that tincture of hamamelis or adrenalin solution would be useful to check the oozing, but the heat and pressure of the sponge usually answer well enough.

No attempt is made to sew up the bladder wound, the two stitches inserted into each edge being secured to the skin. A large soft rubber tube is then inserted and fixed by a stitch; a large absorbent dressing is now applied over the pubes, and retained by a many-tailed bandage. The whole of the urine escapes through the wound for two or three weeks, and very frequent change of dressings and constant attention to cleanliness are required on the part of the nurse.

The bladder should be gently washed out every day with a warm aseptic solution.

The tube and stitches may be removed in two or three days' time. About two to three weeks after the operation the urine begins to pass through the urethra, and this should be favoured by keeping the patient in the sitting posture and getting him out of bed as soon as possible.

If the entire obstruction has been removed, the bladder will regain control in from a month to six weeks after the operation. The condition of "vesical atony" which was supposed to be present in many cases of prostatic enlargement appears to have no real existence (Freyer).

Comments on the Operation.—The smaller the tumour the greater is the difficulty of its removal. This is owing to the fact that the large prostates are almost entirely adenomatous growths, which shell out with surprising facility. On the other hand, a firm, hard prostatic ring at the neck of the bladder will prove to be largely fibrous, and if this condition is found on opening the bladder the surgeon should limit his operation to cutting away the actual projection.

Prostatic obstruction is occasionally due to carcinoma of the gland, and although it may be possible to shell out such a gland (Mr. Reginald Harrison and others have recorded examples), the relief given can only be temporary, and is obtained at serious risk.

When the obstruction is found to be due chiefly to a very vascular and loose mucous membrane with but slight enlarge-

ment of the prostate, Mr. Bruce Clarke recommends cauterisation with Paquelin's or the galvano-cautery through the suprapubic wound.

In certain cases, after enucleating the prostate, the surgeon has drained the bladder through the perineum as well as above the pubes, but this should be avoided as a rule.

Perineal Prostatectomy.—In America removal of the prostate from the perineum has been especially advocated, but seeing that the growth usually projects upwards into the bladder far more than towards the perineum, the advantage of this route is very doubtful. One drawback is the great depth of the wound. A brief description of this procedure must suffice here.

The patient being in the lithotomy position, a curved incision is made in front of the anus and its sphincter, and the dissection carried down carefully to the fascial sheath of the prostate. It may be then possible "by incision of the capsule upon either side in the direction of the fibres of the levator ani to enucleate the two halves of the gland by the forefingers without opening the urethra" (A. B. Johnson of New York). It is almost incredible that a large tumour projecting into the bladder can thus be removed. The proposal to open the prostatic urethra and to draw down the mass with finger or special traction instrument introduced through it into the bladder is more reasonable. Although drainage may be more efficient from the perineum than above the pubes, it can hardly be doubted that the suprapubic operation gives the better access in the majority of cases.

Mortality of the Suprapubic Operation.—This has already been discussed. Mr. P. J. Freyer, up to July 4th, 1903, has operated on forty-five cases with five deaths (8 per cent.). The chief dangers are (1) hæmorrhage and cystitis; (2) kidney disease; (3) bronchitis or pneumonia; (4) shock and exhaustion.

CHAPTER VIII.

RUPTURE OF THE BLADDER.

THE treatment of rupture of the bladder by operation is of quite recent date.

History.—Benjamin Bell suggested suture of the bladder for rupture in 1789; and in later times Grandchamps, Gross, Cusack, and Holmes advocated the same measure. The first operations in England were performed by Heath (*Med.-Chir. Trans.*, vol. lxii.) and Willett (*St. Bartholomew's Hospital Reports*, vol. xii.), but in both instances without success.

Mac Corniac's first operation was performed on September 22nd, 1885.

Norton collected twenty-seven examples of the operation. Of this number, ten recovered and seventeen died—a mortality of 62·9 per cent.

McLaren (*Brit. Med. Journ.*, July 12, 1902) states that up to that date there were records of twenty-three recoveries after operation, but probably this is far short of the total number of successful cases, many escaping publication.

The rent in the bladder is usually vertical in direction and situated high up on the posterior surface. It nearly always involves the peritoneum, so that the urine escapes into the peritoneal cavity. After an injury to the lower part of the abdomen, if the cardinal symptom of vesical rupture—the frequent passage of small quantities of bloody urine—be present, with perhaps evidence of intraperitoneal effusion, no time should be lost in performing abdominal section. Every hour is of importance, for once general peritonitis has come on the operation is probably useless.

Operation.—An incision is made in the median line, immediately above the pubes, and the abdomen is opened in the

usual way. The incision must be free, and in Mac Cormac's cases was six inches in length. Blood-stained urine and serum will probably escape as soon as the peritonéal cavity is opened. The depths of the wound should be exposed as well as is possible by means of strong rectangular retractors, and assistance may be obtained from a small electric lamp.

The posterior surface of the bladder is well exposed. The intestines are pushed upwards, and are kept out of the way by means of suitable sponges.

Search is made for the rent, which will most usually be found upon the posterior surface, midway between the summit and the base of the viscus. If a catheter has been already introduced, it will be felt through the rupture. If the rent be low down in the bladder, some assistance may be derived from the use of the rectal bag, which will probably bring the parts better into view. In one case Sir W. Mac Cormac divided the parietal peritoneum transversely on either side of the bladder, and then found that the organ could be brought further towards the surface wound.

The parts having been well cleaned with a sponge, the sutures are at once introduced. The sutures should be inserted by Lembert's method. The best suture material is fine sterilised silk, and each stitch is introduced by means of a curved needle, held in a needle-holder. The sutures must be applied closely: about four to the inch will suffice. In one of Mac Cormac's cases the rent measured four inches, and required sixteen sutures; in the other case the wound was two inches long, and twelve sutures were applied. The threads should include only the serous and muscular coats, and must on no account involve the mucous membrane. In tying the sutures, care must be taken that the edges of the wound are so inverted as to bring the two serous surfaces into even contact. It is well to begin the closure of the rent at its lowest point. The margins of the rent may perhaps be steadied by means of a blunt hook introduced into one end of the fissure. Mac Cormac advised that the sutures should be continued for some little way beyond the angles of the wound, in order to add to the length of infolded tissue, and to strengthen the suture line.

When all the sutures have been tied, a warm boracic solution should be injected into the bladder, in order to test the soundness of the seam. Any weak or suspicious spot in the suture line should be strengthened by the insertion of additional sutures.

The peritoneal cavity, and especially the pelvis, must now be thoroughly flushed out and sponged. Care must be taken that no sponges are left behind.

The parietal wound is then closed with sutures in the usual way.

If the rent in the bladder has been securely closed, and if the peritoneal cavity has been well flushed out, there is no need to employ a drainage-tube in the parietal wound.

There is also no need to drain the bladder, either by a perineal incision or by a retained catheter. Mac Cormac advised that the bladder should be left alone. If the patient cannot readily pass water, a soft catheter may be used as often as is required.

CHAPTER IX.

OPERATIVE TREATMENT OF STRICTURE OF THE URETHRA.

CASES of stricture at or close to the meatus, which are quite exceptional, should be treated by incision with a blunt-pointed bistoury or tenotome, followed by the regular passage of a large-sized bougie (if possible, No. 25 French). In every other case of stricture the treatment by gradual dilatation with flexible bougies should be tried. Only when this fails—either from impermeability to the instruments, from extreme resiliency of the stricture or irritability of the urethra—should an operation be resorted to. The best operation, provided that a fine bougie can be introduced as a guide, is unquestionably internal urethrotomy. If no bougie, however small, can be passed through the stricture, the operator may be obliged to perform Wheelhouse's operation. Finally, he may be compelled in the worst and most neglected cases to make an artificial opening into the perineal urethra without attempting to cure the stricture (Cock's operation). It will be seen that internal urethrotomy is reserved for a small percentage of cases (those in which gradual dilatation fails), whilst external urethrotomy should be regarded as the last resort of the surgeon, though it should be noted that many surgeons do not so regard external urethrotomy, and perform it in preference to the internal operation. The former is certainly, however, attended with greater risk, and always causes a fistula for a time, occasionally for months or years. Convalescence from internal urethrotomy, on the other hand, is a matter of a week or two.

With regard to **gradual dilatation** a few words may not be out of place.

1. The greatest care should be taken as to asepsis. Before passing any bougie or catheter, the meatus and glans penis should be thoroughly cleansed with carbolic lotion or other antiseptic, and the bougies and syringe should be perfectly clean. Partly for this reason, bougies should always be used in preference to catheters for dilating a stricture.
2. The patient's urine should be kept in as healthy a condition as possible. Regular living, avoidance of alcohol, and the internal use of urotropin or salol (twenty to thirty grains a day) should be enjoined whilst the treatment is being carried on.
3. The best bougies are those made with the distal half more flexible and tapering than the proximal end. The flexibility of the former almost prevents the risk of making false passages, whilst the firmness of the latter is a great advantage in manipulation. They should be graduated on the French scale (in millimetres of circumference).
4. The pain or discomfort of having a stricture dilated is lessened by the injection and retention for several minutes of a solution of eucaine or cocaine (4 per cent.). Internal urethrotomy may be done under one of these local anæsthetics, but it is generally advisable to give ether, etc.
5. In gradual dilatation, as soon as a size is reached when the bougie is tightly gripped, it should be left in from fifteen to thirty minutes, and then an attempt made to pass a larger size, but without using force. It is important not to cause any material pain or bleeding, to rest the urethra for a day or two—in a word, to make haste slowly.

INTERNAL URETHROTOMY.

Although this operation is most successful in properly selected and prepared cases, yet it has sometimes been followed by grave results. Amongst these may be mentioned fatal

hæmorrhage from wound of the dorsal vein of the penis, suppression of urine following severe rigors, and pyæmia or septicæmia. These results ought never to occur, provided the following rules are carried out :—

1. The urethral wall should not be incised deeply in the middle line towards the pubes, but should be slightly notched on either side, so as to get the same effect with two superficial cuts as with one deep one.
2. The operation should never be undertaken whilst the urine is in an unhealthy condition (*i.e.* containing pus or quantities of micro-organisms). This point is of great importance.
3. The patient should be prepared as carefully for this as for any other operation ; he should have had light diet, no stimulants, an aperient, and twenty-four hours' complete rest beforehand.

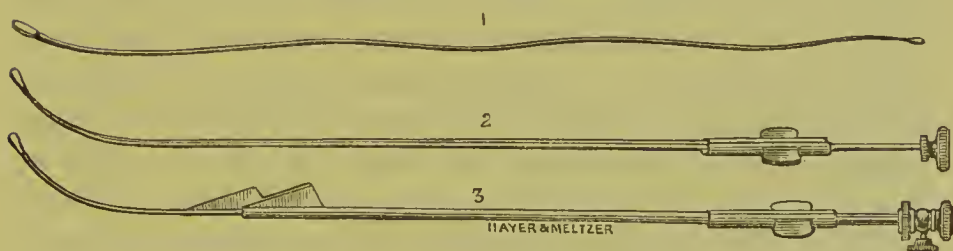


Fig. 445.—TEEVAN'S URETHROTOME.

1, Bougie to act as guide. 2, Fine staff and stiletto. 3, The complete instrument with knife-blade protruded.

A great variety of urethrotomes have been devised, but Teevan's modification of Maisonneuve's instrument (Fig. 445) is perhaps the best. In this the knife-blade is made to divide the stricture from in front, Teevan's improvement consisting in a guide bougie of fine calibre, which is screwed on to the end of the urethrotome, and is passed on into the bladder. Before use, the instrument should be carefully examined, so as to avoid the risk of the bougie breaking off, etc. The guide bougie must be flexible, and yet with sufficient rigidity to enable the stricture to be passed.

The urethral canal is straightened by the surgeon making traction with the left hand whilst the bougie is intro-

duced. If the stricture be very tight, the instrument is apt to double back, in which case another bougie should be tried. As soon as there is no doubt it has entered the bladder, the urethrotome is screwed on to the bougie, and both are well oiled, the instrument being then passed onwards until the knob of the urethrotome presses against the stricture. The urethrotome is depressed so that its handle lies between the patient's thighs. The knife-blade is then made to protrude one or two millimetres from its guard, and the stricture divided on either side of the median line. After each cut of the knife, the latter is withdrawn within its guard. When it is thought that the stricture is sufficiently cut, the urethrotome and guide are withdrawn, and a large-sized Lister's metal sound is passed.

It may be necessary to reintroduce the urethrotome and repeat the notching, and the surgeon should not be content until a full-sized Lister's sound or a bougie of the size of No. 25 (French) can be readily passed. The hæmorrhage is, as a rule, very slight. Finally, a full-sized silver catheter is passed and the bladder emptied. During the whole operation, the patient must be warmly wrapped up in blankets, and the same precaution observed afterwards. It is best not to leave a catheter in the urethra, and to allow the parts to rest for two or three days before again passing a Lister's sound of large calibre or a flexible bougie. Subsequently the regular introduction of the latter must be insisted on to prevent recurrence of the stricture.

Complications and Modifications of the Operation.—A troublesome accident that may easily happen is the breaking off of the bougie close to its attachment to the urethrotome. This is especially apt to occur if there has been a crack in the coating material of the bougie which has escaped notice. In such a case the urethrotome should be withdrawn entirely (after division of the stricture), and a lithotrite or similar forceps introduced in order to seize and extract the bougie. Should these attempts fail, the patient should be placed in the lithotomy position, and a median section—into the membranous urethra—performed on a grooved sound. The finger can then be introduced into the bladder, and with its aid the exact position

of the bougie detected and the instrument removed by straight dressing forceps.

Mr. Buckston Browne advocates the urethrotome of Civiale and Sir Henry Thompson—*i.e.* one that cuts from the bladder side of the stricture forwards. He makes the incision on the floor of the urethra, and states that it should be “one inch long and half an inch deep.” No object can be gained by such a long incision for the majority of strictures, which are simply annular; whilst half an inch is an extravagant depth which probably is rarely attained, and is certainly not required.

The drawback to the urethrotomes which cut from the bladder side of the stricture is that they cannot be introduced until a No. 8 or 10 French bougie will pass.

Besides the two forms of urethrotome mentioned above, there are a legion of others, one catalogue figuring no less than thirty-six varieties, which have been still further added to of late years.

Should hæmorrhage occur after internal urethrotomy an ice-bag should be applied to the perineum with elevation of the pelvis, or a full-sized catheter (flexible if possible) may be passed and left in, whilst a firm pad of wool is fixed in the perineum by a T-bandage. The catheter should be kept clear, and the urine should run continuously through it and an attached rubber tube. An opiate should be given if there is pain or restlessness.

As already mentioned, hæmorrhage depends on too deep a single incision having been made in the roof of the urethra, and is to be avoided by making two smaller cuts, one on either side.

To avoid rigors after internal urethrotomy, the patient should be kept thoroughly warm in bed, should not try to pass urine for a few hours, and should drink freely warm water or weak tea. If a rigor should occur, it should be met by the immediate administration of ten grains of quinine in hot brandy and water.

EXTERNAL URETHROTOMY.

The operations known by this name include several methods of opening the urethra by an incision in the perineum.

They are carried out in certain cases of stricture of the urethra which have resisted other methods of treatment, and which are, for one reason or another, unsuited for less severe surgical measures.

The following are the operations described :—

1. *Syme's Operation*.—In this operation a staff is passed through the obstruction, and upon it the stricture is divided.

2. *Wheelhouse's Operation*.—Here the urethra is opened upon the distal side of the stricture. The orifice of the narrowed canal is exposed, a director is passed into it, and guided by this instrument the surgeon divides the stricture.

3. *Cock's Operation*, or *Perineal Section*.—In this procedure the urethra is opened behind the stricture, and just in front of the prostate. No staff or artificial guide of any kind is used. The operation is applied to cases in which the urethra is practically impermeable. (*See page 639.*)

The term external urethrotomy is also employed in connection with the opening of the normal urethra through the perineum, for the purpose of draining the bladder.

This measure consists merely in opening the urethra immediately in front of the prostate by cutting upon a staff. After the incision is completed, the staff is withdrawn, and a perineal tube is passed into the bladder.

The general details of this simple operation are considered in the chapter on Median Lithotomy (page 588).

1. **Syme's Operation.** — *Instruments Required.* — Syme's staff. (This instrument has a narrow terminal part, which is passed through the stricture. Where this part joins the rest of the staff, there is a "shoulder," which rests against the distal surface of the stricture. The narrow segment is grooved, and the groove is continued on to the shoulder.) Manacles or Clover's crutch; scalpel; probe; director; Teale's probe gorget (Fig. 446); perineal tube; catheter.

The Operation.—The patient is placed in lithotomy position, and the staff is introduced with the care already advised in that operation (page 577). An incision is made precisely in the median line of the perineum, and the knife is so directed that its point shall hit the shoulder of the instrument. The surgeon

must convince himself that this portion of the staff is laid bare. He then engages the point of the knife in the groove of the staff, and, keeping most carefully to the groove, thrusts the knife towards the neck of the bladder until he has divided the whole of the stricture. A director or probe, or Teale's probe gorget, is now introduced along the convexity of the staff into the bladder, and the staff is removed. A gum-elastic catheter may then be passed into the bladder through the penis, and be guided into position by the director or probe gorget, aided by the finger inserted into the wound.



Fig. 446.—TEALE'S PROBE GORGET.

Should the irritability of the bladder prevent the retention of a catheter, a tube should be passed into the bladder from the perineum, and should be retained in position by tapes. (See pages 581 and 641.)

Syme's curved perineal catheter may be employed for this purpose, or a portion of a gum-elastic catheter be made use of. Whitehead's perineal tube, with sliding adjustable shield, is a useful instrument.

As soon as possible, however, a catheter should be passed by the meatus, and the perineal wound allowed to close.

2. Wheelhouse's Operation.—*Instruments Required.*—Manacles or Clover's crutch; Wheelhouse's hooked staff (Fig. 447); two pairs of fine-nibbed forceps; scalpels; catheters; probe;



Fig. 447.—STAFF FOR WHEELHOUSE'S OPERATION.

probe-pointed director; Teale's probe gorget (Fig. 446); curved needles; needle-holder; artery and pressure forceps; sponges in holders.

The Operation.—The patient is placed in lithotomy position. "The staff is to be introduced with the groove looking towards

the surface, and brought gently into contact with the stricture. It should not be pressed much against the stricture, for fear of tearing the tissues of the urethra and causing it to leave the canal, which would mar the whole after-proceedings, which depend upon the urethra being opened a quarter of an inch in front of the stricture. Whilst an assistant holds the staff in this position, an incision is made into the perineum, extending from opposite the point of reflection of the superficial perineal fascia to the outer edge of the sphincter ani. The tissues of the perineum are to be steadily divided until the urethra is reached. This is now to be opened in the groove of the staff, not upon its point, so as certainly to secure a quarter of an inch of healthy tube immediately in front of the stricture. As soon as the urethra is opened, and the groove in the staff fully exposed, the edges of the healthy urethra are to be seized on each side with straight-bladed nibbed forceps, and held apart. The staff is then to be gently withdrawn until the button-point appears in the wound. It is then to be turned round, so that the groove may look to the pubes, and the button may be hooked on to the upper angle of the opened urethra, which is then held stretched open at three points, and the operator looks into it immediately in front of the stricture. While thus held open, a probe-pointed director is inserted into the urethra, and the operator, if he cannot see the opening of the stricture—which is often possible—generally succeeds in very quickly finding it, and passes the point onwards through the stricture towards the bladder. The stricture is sometimes hidden amongst a crop of granulations or warty growths, in the midst of which the probe-point easily finds the true passage. The director having been passed into the bladder (its entrance into which is clearly demonstrated by the freedom of its movements), its groove is turned downwards, the whole length of the stricture is carefully and deliberately divided on its under-surface, and the passage is thus cleared. The director is still held in the same position, and a straight probe-pointed bistoury is run along the groove, to ensure complete division of all bands or other obstructions. These being thoroughly cleared, the old difficulty of directing the point of a catheter through the divided

stricture and onwards into the bladder is to be overcome. To effect this, the point of a Teale's probe gorget (Fig. 446) is introduced into the groove in the director, and, guided by it, is passed onwards into the bladder, dilating the divided stricture and forming a metallic floor, along which the point of the catheter cannot fail to pass securely into the bladder. The entry of the gorget into the latter viscus is signalled by an immediate gush of urine along it. A silver catheter (No. 10 or 11) is now passed from the meatus down into the wound, is made to pass once or twice through the divided urethra, where it can be seen in the wound, to render certain the fact that no obstructing bands have been left undivided, and is then, guided by the probe-dilator, passed easily and certainly along the posterior part of the urethra into the bladder. The gorget is now withdrawn, the catheter fastened in the urethra, and allowed to remain for three or four days, an elastic tube conveying the urine away. After three or four days the catheter is removed, and is then passed daily, or every second or third day, according to circumstances, until the wound in the perineum is healed; and after the parts have become consolidated, it requires, of course, to be passed still from time to time, to prevent re-contraction" (Wheelhouse, *Brit. Med. Journ.*, June 24, 1876).

The operation requires a good light and infinite patience. There is often some difficulty in detecting the orifice of the stricture, and matters may be complicated by a false passage.

The hooking of the button of the staff on to the upper angle of the opened urethra is not always of service. The instrument has to be held by an assistant, and is apt to be in the way. The margins of the urethral wound may be conveniently held aside by long threads which have been passed by means of curved needles in holders.

3. Cock's Operation. — This operation consists in opening the urethra behind the obstruction, and at the apex of the prostate, unassisted by a guide. It is a modification of the old *boutonnière* operation, is sometimes spoken of as "perineal section," but is more correctly represented by the title "external urethrotomy without a guide."

Instruments Required.—Manacles or Clover's crutch; a broad double-edged knife with a very sharp point; a probe-pointed director in a handle (the handle and the shaft of the instrument should form such an angle as is observed in Teale's probe gorget); a perineal cannula; a gum-elastic catheter, to be retained in the bladder through the perineum.

The Operation.—The operation is thus described in the *Guy's Hospital Reports* for 1866 :—

"The patient is to be placed in the usual position for lithotomy; and it is of the utmost importance that the body and pelvis should be straight, so that the median line may be accurately preserved. The left forefinger of the operator is then introduced into the rectum; the bearings of the prostate are next examined and ascertained, and the tip of the finger is lodged at the apex of the gland. The knife is then plunged steadily and boldly into the median line of the perineum, and carried on in a direction towards the tip of the left forefinger, which lies in the rectum.

"At the same time, by an upward and downward movement, the vertical incision may be carried in the median line to any extent that is considered desirable. The lower extremity of the wound should come to within half an inch of the anus.

"The knife should never be withdrawn in its progress towards the apex of the prostate, but its onward course must be steadily maintained until its point can be felt in close proximity to the tip of the left forefinger. When the operator has fully assured himself as to the relative position of his finger, the apex of the prostate, and the point of his knife, the latter is to be advanced with a motion somewhat obliquely, either to the right or the left, and it can hardly fail to pierce the urethra. If, in this step of the operation, the anterior extremity of the prostate should be somewhat incised, it is a matter of no consequence.

"In this operation it is of the utmost importance that the knife be not removed from the wound, and that no deviation be made from its original direction until the object is accomplished. If the knife be prematurely removed, it will probably, when re-inserted, make a fresh incision and complicate the desired result. It will be seen that the wound, when completed, represents a triangle; the base being the external vertical incision through the perineum, while the apex, and consequently the point of the knife, impinges on the prostate.

"The knife is now withdrawn, but the left forefinger is still retained in the rectum. The probe-pointed director is carried through the wound, and, guided by the left forefinger, enters the urethra and is passed into the bladder."

Along the groove of the director the cannula or perineal tube is passed into the bladder.

It only remains to secure this drainage-tube in place by means

of two tapes, which are attached to the sides of the tube on the one hand, and to the perineal strips of a T-bandage on the other.

Through the tube the bladder may be washed out. The stricture may now possibly be dealt with by such means as appear advisable. The operation is, however, usually carried out in cases in which the urethra is permanently obstructed or destroyed, in which urinary extravasation has taken place, and in which the perineum is infiltrated with inflammatory exudations, and probably riddled with sinuses.

The perineal opening is, therefore, as a rule, a permanent one; but should the urethra be once more restored to its normal calibre, the artificial opening in the perineum soon heals up.

There is no doubt that this operation may prove to be exceedingly difficult. It needs to be carried out with the utmost patience, care, and precision:

Repeated stabs in the dark may lead to severe bleeding; and if the urethra be not reached at the first or second attempt, the operation had better be abandoned.

Excision of the Strictured Portion of Urethra.—In a small number of cases this has been carried out with success. It is best suited for tight annular strictures which resist the ordinary measures of treatment. A traumatic stricture in a young adult may be taken as an example. A careful dissection from the perineum is made, the narrowed portion exposed, and the urethra divided transversely in front of and behind the stricture. After the intervening part has been cut away with scissors, the two ends are brought together by fine catgut sutures inserted first into the dorsal surface of the wall. The suturing is completed over a catheter, which should be left in for a few days. Extra sutures of silkworm gut through the overlying tissues and skin should be inserted to relieve the tension on the deep ones. The proceeding is of very limited application, and may be attended with much difficulty. Unless perfect suturing and union be obtained, the stricture may be in no way improved. Successful cases have been recorded by Mr. Pearce Gould, Mr. T. H. Openshaw, and others.

Part XII.

*OPERATIONS UPON THE SCROTUM
AND PENIS.*

CHAPTER I.

OPERATIVE TREATMENT OF VARICOCELE.

Anatomy of the Cord.—The vas deferens lies at the posterior aspect of the cord, and is to be easily recognised by its whipcord-like density when rolled between the thumb and finger. A considerable amount of connective tissue surrounds the vas and the blood-vessels of the cord. Three arteries occupy the cord: the spermatic, from the aorta, lies in front of the vas; the deferential artery, from the superior or inferior vesical, lies by the side of the vas; the cremasteric artery, from the deep epigastric, lies among the superficial layers of the cord and in its outer segment (Fig. 448).

The first-named vessel is the size of the posterior auricular, and the two latter the size of the supraorbital.

The veins of the cord have been elaborately investigated by Mr. Walter G. Spencer, to whom I am indebted for the section from which Fig. 448 is drawn.

The veins are divided roughly into two sets. The anterior and by far the larger set runs with the spermatic artery, is bound together by a good deal of connective tissue, and forms the pampiniform plexus. The posterior set is small, and surrounds the vas deferens, running with the deferential artery. A few isolated veins, independent of these sets, are found among the tissues of the cord.

It would appear from Mr. Spencer's inquiries that the veins in the left cord are always larger than those of the right; and in connection with this point it may be observed that the congenital origin of varicocele is very generally allowed.

In severe cases of varicocele all the veins of the cord would appear to be involved. In ordinary cases the veins only of the pampiniform plexus are sufficiently dilated to require treatment.

In the operation of excision I have been in the habit of removing only the veins forming the pampiniform plexus, and have left those accompanying the deferential artery.

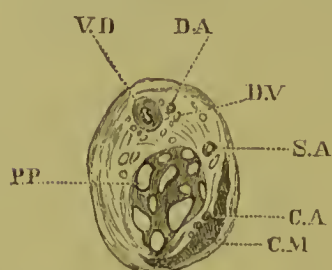


Fig. 448.—SECTION OF THE LEFT SPERMATIC CORD OF AN ADULT, AT THE LEVEL OF THE EXTERNAL ABDOMINAL RING. VIEWED FROM ABOVE. (*From a specimen prepared by Mr. W. G. Spencer.*)

V.D., Vas deferens; D.A., Deferential artery; D.V., Deferential veins; S.A., Spermatic artery; C.A., Cremasteric artery; C.M., Cremaster muscle; P.P., Pampiniform plexus.

It must be remembered that the testicle is a vascular gland, and that it is possible to so far occlude the veins returning from the organ as to lead to serious disturbance (page 648).

In some cases of varicocele there is present, besides the dilated veins, a condition of extreme laxity of the scrotal skin, the dartos, and the other coverings of the testis. From this cause the organ hangs very low, sometimes as much as eight inches from the external ring, and

mere excision of part of the veins will not restore it to the normal level. In a case of this kind it is best to excise a considerable piece of scrotal skin and dartos at the same time that the pampiniform plexus is dealt with, but in the great majority of cases resection of the veins will suffice. Before the introduction of antiseptic and aseptic measures various methods of subcutaneous ligature or division were employed, but the only satisfactory and safe operation consists in exposing the anterior bundle of veins by a short incision through the coverings of the cord, isolating the veins from the vas deferens, etc., applying a double ligature, excising the bundle for a distance of one or two inches, and securing the two severed ends together.

Some difference of practice exists as to the exact position of the skin incision. The veins are largest near the testis, but wounds made through the scrotum are more difficult to keep aseptic than those made towards the inguinal canal. For this reason, as in herniotomy, the tendency of late years is to place the incision higher up than formerly. If the relaxed scrotum requires to be dealt with, it is best to make the two wounds quite independent.

Preparation of the Patient.—The pubic area should be carefully shaved (on both sides) the day before the operation, the skin thoroughly cleansed, and an antiseptic compress applied. The delicate nature of the scrotal integument should be borne in mind, and strong antiseptic solutions avoided both before and during the operation. The bowels should have been well opened.

Steps of the Operation.—The operator stands on the left side, one assistant raises and steadies the cord by holding the testis with his fingers from below, whilst another sponges. An incision is made, one and a half inches long, parallel to and directly over the cord, immediately below the external ring. The cut divides skin, connective and fatty tissue, the intercolumnar fascia, and the cremaster layer. The latter is easily recognised by its longitudinal muscle bands. The edges of this fascia are then held aside by Wells's forceps, and the anterior bundles of veins comes into view covered by the thin infundibuliform fascia. The latter is then carefully divided and peeled off with forceps, so that an aneurysm needle can be introduced under the veins, but in front of the vas deferens. The veins must be perfectly bared, and cleanly exposed. It must be ascertained for certain that the vas and the vessels which lie behind it are not included. A catgut ligature of medium thickness is then drawn under the anterior bundle, which is cleared of surrounding tissues for a distance of about two inches. If it is desired that the lower part of the veins should be ligatured rather than the upper they can be easily reached by making traction on the cord. A second ligature is introduced, and the veins are then ligatured in two places, about one inch and a half apart. The lower ligature should be tied first. The

vessels so isolated are divided with scissors close to the ligatures and removed.

The amount excised will be represented by about one inch, the scissors being applied about a quarter of an inch from the ligature.

There is no need to clamp the veins above the site of the proposed excision in order to render them distinct.

Almost invariably the spermatic artery will be included in the ligatures, as it lies surrounded by the veins of the anterior bundle.

Occasionally the artery can be identified and held aside, but this is rarely possible, nor does it appear to be at all important. After the intervening portion has been excised, the two cut ends are secured together by tying the two ligatures above to those below. This union may be reinforced by a few fine catgut stitches introduced with a curved needle through the opposing empty vessel-ends.

If two pairs of dissecting forceps are gently used in clearing the varicocele from the surrounding tissues, there is little risk of damaging the vessels. The action of the forceps must be supplemented by the scalpel. There must be no tearing of the fascia asunder with the fingers.

There will probably be no bleeding points to secure.

A blunt hook having been inserted at each extremity of the wound, in order to bring the edges of the incision parallel, the sutures are introduced. Fine red silkworm gut should be employed. Colourless gut sutures are apt to be overlooked. Fine catgut also makes an excellent suture material. The wound is dressed with iodoform sterilised gauze and wool, and a spica bandage applied as for hernia. It is well to support the testes on a small pillow by some simple form of suspender.

If the wound has been made lower down through the scrotum, it must be protected by a dressing enveloping both testes. This is somewhat difficult to keep in place, and is uncomfortable in hot weather. Celloidin or collodion dressings cannot be used to the scrotal skin, as they irritate it too much. The wound is a very small one, and if made over the cord just as it emerges

from the external ring, a light dressing can be easily retained by means of the spica bandage.

The first dressing need not be changed until the fourth day, and the sutures may be removed on the seventh.

Healing by first intention is the rule after this operation. The patient should be kept in bed for from seven to fourteen days. At the end of three weeks he will probably be able to resume his work. He should wear a suspender for at least a month after he has begun to move about.

Modifications.—Some surgeons use silk for ligaturing the veins. The objections to this are the same as in the case of radical cure of hernia. In a large number of operations we have been thoroughly satisfied with catgut (not chromicised) for the purpose.

Excision of part of the Scrotum.—This proceeding should be reserved for the exceptional cases of extreme laxity of the skin and muscles supporting the testicle. The pendulous scrotum is drawn through a pair of narrow bladed curved forceps, such as are used in circumcision, until the testis is seen to be well braced up. The forceps (their convexity being downwards) are then held firmly whilst the redundant tissues are excised with a sharp-pointed bistoury. On relaxing the grip of the forceps there will be free oozing from the scrotal veins and arterial twigs. This should be thoroughly stopped by pressure forceps, and if necessary by ligature, before the wound is sewn up. All sutures in the scrotum must be introduced close to the edges of the wound; otherwise the dartos tucks in the skin and prevents rapid healing.

Excision of the redundant scrotum is usually combined with operation on the veins of the cord, as already described.

Results of Open Ligature and Resection in Varicocele.

—So far as my experience goes, the result of the operation is certain; and the procedure may claim to effect a radical cure. The wound heals well, and I have never met with a single case of secondary hæmorrhage, abscess, or phlebitis. The after-treatment is not painful. There may be some œdema of the scrotum, and a little engorgement of the testis; but among a

now considerable number of cases I have never met with an example of orchitis.

It is important that the pampiniiform plexus or anterior bundle only should be dealt with. Mr. Jacobson (Holmes's "System of Surgery," vol. iii., page 571) mentions a case where some gangrene of the testis followed the excision, due, he believes, to the inclusion of too many veins in the ligatures. The veins which accompany the vas deferens should be left untouched.

There is not the least doubt but that the main trunk of the spermatic artery is often included with the veins, and is divided. No harm follows this division. The testicle does not slough, as some have surmised, nor does it become violently inflamed, nor does it undergo atrophy. The artery to the vas deferens certainly escapes injury, and appears to bring enough blood to the testicle by means of its anastomosing branches with the spermatic to maintain the healthy life of the testicle.

CHAPTER II.

OPERATIVE TREATMENT OF HYDROCELE.

THE chief palliative measure consists of repeated simple tapings. The curative measures have for their object the obliteration of the hydrocele sac.

Under this head will be considered the treatment by injection, by incision, and by excision of the parietal part of the sac.

In the present sections it is considered that the hydrocele of adults is referred to. In the treatment of the hydrocele of infants and young subjects certain especial points are involved which need not be dealt with here.

Simple Tapping.—The position of the testicle must be made out by means of the patient's sensation, the use of transmitted light, and by following the vas deferens into the scrotum. In inversion of the testis—a condition where the epididymis lies to the front—the gland may be applied to the anterior wall of the sac, and be immediately pierced in tapping at the usual site.

The patient should stand with his back against a wall; or, if he be old or nervous, may lie on his side at the edge of a bed. I have seen this little operation attended by alarming faintness.

The scrotal tissues are grasped from behind with the left hand, and the skin over the front of the swelling thus made as tense as possible. The skin should be carefully cleansed all round the site of puncture with 1 in 20 alcoholic solution of carbolic acid. The trocar and cannula must be sterilised in boiling water before being employed. It is important that the

cannula should fit close. The nail of the right forefinger is placed on the trocar one inch from the point, to prevent too deep a plunge. The instrument is stabbed sharply into the sac at about the junction of its middle and lower thirds. The site of any visible vein is avoided. The instrument is first directed backwards, and then, when it is well into the sac, is sharply turned upwards to avoid the testicle. All the fluid should be removed, and then a little tuft of sterilised wool should be applied with collodion over the puncture.

The patient should wear a suspender. He should, if possible, rest in the recumbent posture for the remainder of the day of the operation.

Some of the fluid may escape into the scrotal tissues and lead to a little œdema, which soon subsides. If a vessel be pricked, a considerable ecchymosis of the entire scrotum may result. If the trocar be blunt, or the cannula ill-fitting, or if the sac be thick, and the puncture be made in a hesitating manner, the tunica vaginalis may be pushed in front of the point of the instrument. Hæmatocele has in comparatively rare cases followed simple tapping. In such instances the testis may have been pricked, or has been the subject of disease, or the patient has engaged in active work directly after the operation. Occasionally the sac fills with dark brown fluid exactly like tincture of iodine, except for the smell and chemical reaction. If a foul trocar be used, suppuration of the sac may follow, and this may prove fatal in old and weakly subjects. A fresh tapping will probably be required at an interval of from three to six months.

Treatment by Injection.—The sac having been entirely emptied by tapping, the nozzle of a special syringe is applied to the cannula, and some irritant injected. The operation is most conveniently done while the patient stands. Iodine and carbolic acid are the substances most frequently used for the injection.

Iodine.—The following solution may be employed:—Iodine, forty grains; iodide of potassium, thirty grains; water, one ounce. Neither the ordinary tinctura iodi nor the liquor iodi is strong enough for efficient use in the majority of cases.

From three to four drachms should be injected and retained, and be brought into contact with all parts of the sac by rubbing the walls together after the cannula has been removed. The puncture may be covered by a piece of strapping or a tuft of sterilised wool. Some surgeons inject a larger quantity of fluid, and allow half of it to escape after it has been brought well in contact with the interior of the sac. Mr. Jacobson injects two to three drachms of the tincture of iodine of the Edinburgh Pharmacopœia, and allows the whole to remain.

Little pain, or only a feeling of heat, may follow the operation. On the other hand, the pain may be severe and nauseating, and may spread to the perineum, the loins, or the neck of the bladder. The patient may faint.

Within twelve hours the scrotum will probably be swollen to its previous size, the parts are red and tender, and the reaction is attended with some fever. The patient should lie in bed with the scrotum well supported. He will probably have to keep his bed for four or five days, and then will have to wear a suspender for a considerable time. Some three or four weeks will elapse before the parts will be restored to their normal condition. The inflammation excited may be of so insignificant a degree as to produce no curative result. On the other hand, it may assume serious proportions, and call for the use of ice-bags and the free administration of opium.

I have noticed that the inflammatory swelling that follows the successful use of iodine injection is sometimes tympanitic on percussion—an occurrence possibly due to the conversion of some of the iodine into vapour.

Carbolic Acid.—Five to thirty drops of pure phenol (liquid carbolic acid) are injected and left in the sac. The patient should rest for a day or two. The reaction varies much in different patients. From two to six weeks will elapse before the exudation is absorbed. In suitable cases it appears that three out of four will be cured by this method. It is claimed that carbolic acid excites less pain than iodine, and is more uniform and certain in its results.

Other injection materials are rectified spirit, and sulphate or chloride of zinc in solution.

Excision of the Parietal Part of the Sac.—This operation is the most certain to lead to a cure of the hydrocele, and conforms to the modern principles of surgery. It is doubtful by whom it was first introduced. Von Bergmann advocated it in 1885 (*Berlin klin. Woch.*, p. 209), though Mr. John Couper at the London Hospital was in the habit of performing it for some years prior to this date, and possibly many other surgeons as well. This method is especially adapted for hydroceles of the tunica vaginalis or of the epididymis in adults. Hydroceles of the cord are also best treated by excision, though in this case the entire sac is removed, whereas in hydrocele of the tunica vaginalis only the parietal portion is removed. It will be necessary here merely to describe the latter operation, which may be done under cocaine, though a general anæsthetic is usually necessary.

An incision about three inches long is made over the long axis of the hydrocele at its upper part, and is carried down through the cremasteric layer. With forceps the tissues immediately covering the sac are peeled off on either side, whilst the hydrocele is pushed out of the wound as far as practicable. It is convenient not to open the sac until it has been well laid bare on either side. A puncture is then made and the fluid evacuated; the sac is laid freely open with scissors and then cut away. Care must be taken in doing this to keep just outside the epididymis externally and not to injure the vessels of the cord or the vas deferens internally. It should be remembered that in old hydroceles the body of the epididymis is often displaced from the testis by a pouch. Fig. 449 shows the relation of the upper part of the sac to the cord, etc., and indicates how much may safely be cut away. It is easy to destroy the epithelial covering on the testis by scraping it lightly with a Volkmann's scoop, but it may be doubted whether this is necessary. In any case rough handling of the testis should be avoided. Any bleeding points are secured with pressure forceps, but ligatures are rarely required.

If oozing persists, a small drainage-tube should be inserted at the lower angle of the wound, to be removed twenty-four hours later. The sutures should be of fine silkworm gut, and

should be placed close to the edges of the wound. The ordinary sterilised dressings are applied, and may be kept in place either by means of a T-bandage or, better, by a four-sided piece of linen to each angle of which is sewn a stout tape. These tapes pass round the abdomen and the thighs.

The patient need rarely be confined to bed more than five to seven days, after which time the stitches are removed and a suspensory bandage is worn. Complications of the operation are uncommon, though perfect asepsis is certainly difficult to obtain in this region. Slight orchitis sometimes occurs, but the greatest trouble is met with when the wound has been sewn up before hæmorrhage has ceased. For this reason the surgeon should have the organ brought well out into the wound during the excision of the sac, and should not return it until the bleeding has practically ceased. Lately it has been proposed to modify this operation by inverting the testis and turning the sac inside out. This would certainly be an awkward proceeding in many cases of hydrocele. It would be impossible in hydroceles of the epididymis, and we regard it as distinctly inferior to a careful excision of the parietal layer.

Incision and Drainage of the Sac.—No description is required of this method, which was introduced by Volkmann, and was extensively practised at one time.

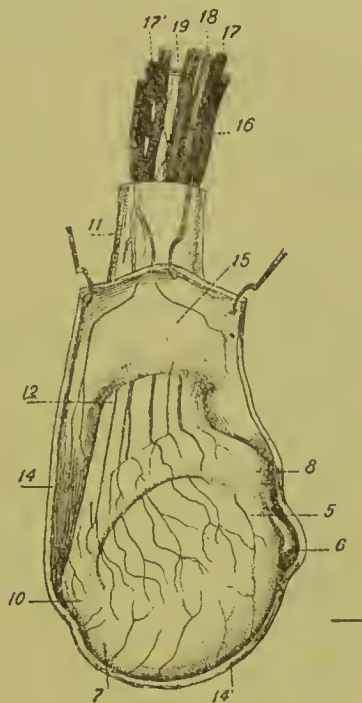


Fig. 449.—NORMAL RELATION OF THE TUNICA VAGINALIS TO THE TESTIS AND CORD, SHOWING THE AMOUNT OF THE SEROUS COAT TO BE EXCISED IN THE RADICAL OPERATION FOR HYDROCELE.

The operator should cut just outside the line of reflection shown in this figure, with particular care not to damage the epididymis or vessels of the cord. 5, Junction of globus major with testis; 6, Hydatid of Morgagni; 7, Junction of globus minor with testis; 8, 14, 15, Tunica vaginalis, parietal layer; 10, Globus minor; 11, 12, Spermatic cord; 16, 17, 18, Anterior bundle of veins and spermatic artery; 19, Vas deferens; 17', Posterior bundles of veins. (*After Testut.*)

Selection of Operation.—In deciding on the method to be employed, it should be noted that injection with iodine, though still largely employed, is by no means certain to cure. In many cases recurrence has taken place. Moreover, there is a good deal of pain attached to this method, more than is experienced after excision of the parietal layer.

The treatment by simple incision and drainage of the sac cannot be recommended, for the following reasons:—

1. It is uncertain in its results—probably more so than injection with iodine.

2. For success it depends upon the drainage exciting inflammation and probably suppuration of a serous cavity. This is opposed to all modern principles.

3. The after-treatment is slow and irksome, and considerably longer than that required in cases of excision.

The only advantage it offers is the fact that a general anæsthetic may usually be dispensed with at the time of the operation.

The choice of procedure for ordinary cases of hydrocele in adults will lie between iodine injection and excision of the sac.

The former is more painful, much less certain in its results, but it does not require so long a rest from active work, and an anæsthetic is unnecessary.

Excision of the sac should certainly be practised under the following conditions: a hydrocele of long standing with thickened wall or sanguineous contents; one of excessive size; or one in which injections have been tried and failed.

It may sometimes be performed under local anæsthetics (eucaine or cocaine, with due precaution as to the dose employed), especially when the hydrocele is small—*e.g.* those of the epididymis.

The treatment of a large hydrocele in an elderly subject should not be lightly undertaken by the surgeon, as a fatal issue has been known to follow even tapping under such conditions.

A large number of cases of hydrocele in children, as well as in adults, require no active surgical measures.

CHAPTER III.

CASTRATION.

Instruments Required.—A median-sized scalpel; scissors; razor; dissecting-forceps; Wells's artery forceps (several pairs); a clamp; two large blunt hooks; aneurysm needle; catgut ligatures; straight needle (two and a half inches); suture material; drainage-tube. The clamp is the only special instrument required; its blades should be protected by rubber to lessen the crushing of the vessels of the cord.

Position.—The patient lies upon the back, with the thigh extended and a little apart. The surgeon stands on the same side of the patient as the organ to be removed. The one assistant required stands on the other side of the table, opposite the surgeon. His most important duty is to keep hold of the cord after it has been divided.

The Operation.—The pubes must be shaved, and the hair removed from the scrotum as far as possible. The scrotum, groin, and perineum should have been previously washed repeatedly, and antiseptic measures adopted (with caution as to the scrotal skin, which is easily made sore by too strong lotions).

The bowels must have been well evacuated by purge and enema. The upper part of the scrotum and the inguinal canal are examined for hernia, and any history of previous hernia inquired into.

The testicle may rest upon a large sponge placed between the thighs. The skin of the scrotum is steadied by the left hand in this manner: the thumb and fingers are separated; the thumb lies on the right side of the swelling, the fingers on the left, the wrist is towards the abdomen, and the finger-tips towards the bottom of the scrotum. The incision is made

between the thumb and the fingers, and by the separation of these the skin is well steadied and stretched.

A vertical incision is carried from a point about one inch below the external abdominal ring to the bottom of the scrotum.

When the skin is involved by the growth, or when it has become adherent to the testis or is the seat of sinuses, two elliptical incisions that clear the affected skin and meet above and below should be made. The position of these elliptical cuts must obviously depend upon the position of the implicated skin, and they may have to be made upon the lateral or even the posterior aspects of the scrotum. In dividing the tissues between the skin and the tunica vaginalis, the soft parts should be gently moved to and fro by the left hand, which still keeps its position on the scrotum. The mobility of the superficial layers is striking, but the tunica as it is approached is recognised by its perfect immobility.

When the skin is involved, this means of noting the progressive depths of the incision is lost.

The testis may be removed without opening the tunica vaginalis. In such case the tunica, as a simple bag, may be separated from the scrotal tissues with the fingers. While this is being done, the assistant should hold the scrotum and the testicle of the opposite side. In a large number of cases, however, it is desirable that the tunica should be opened: first, for diagnostic reasons; second, to lessen the bulk of the swelling when the sac is distended with much fluid; third, when the tunica is adherent, owing to the progress of the growth or the disease.

The testis is now shelled out of the scrotal tissues with the fingers. It is practically torn out, and at this step all cutting should be avoided, except when a point resists the fingers.

Even after the serous sac has been opened, the tunica vaginalis can very usually be shelled out together with the testis, to which it clings.

If the testis alone be disturbed, the connections between the visceral and parietal layers of the tunica must be cut with scissors.

In exposing the tumour, care should be taken not to cut

into it. The operation is complicated by opening an abscess cavity or a cyst, or by cutting into a mass of soft growth.

The cord is now well isolated with the fingers, and drawn down. It is then secured by a clamp. The best clamp for the purpose is a Spencer Wells's large pressure forceps. The assistant holds the clamp, and the surgeon, grasping the testicle, divides the cord with the knife about three-quarters of an inch below the clamp. The vessels of the cord can now be separately secured. Their position has been indicated (page 643). Three arteries must be ligatured—the artery to the vas deferens, the cremasteric, and the spermatic. The deferential artery is found close to the vas. With it are a few veins (the posterior set, page 643). The cremasteric artery lies towards the outer part of the cord and nearer its surface. The spermatic artery is in front of the vas, and is surrounded by the veins of the pampiniform plexus. It is impossible to distinguish the arteries from the veins. The mouths of the latter vessels gape when grasped by the clamp; they are thereby rendered obvious, and are readily secured. Both veins and arteries are picked up with artery forceps, and secured with catgut. The two sets of veins should be tied separately. Three or four ligatures may be required, but very seldom more.

These ligatures should certainly be of catgut and not of silk, for fear of a troublesome sinus resulting. They should be knotted very securely before the clamp is relaxed, and should be left long until it is seen that all the vessels have been well tied.

Any bleeding points in the scrotal incision must be secured. The following vessels are divided—superior and inferior external pubic, superficial perineal, and the artery to the scrotal septum. As a rule, none of these needs a ligature.

In applying sutures, it is best to use a straight needle, and fine silkworm gut or catgut. In order to obtain an even line of union, the edges of the incision should be stretched between two blunt hooks, inserted at the extremities of the wound and held by the assistant. This will prevent the in-turning of the edges of the incision, due to the contraction of the dartos, and will allow of accurate adjustment of the parts. It is well to

introduce all the sutures before tying the first one. A drainage-tube one inch and a half long may be secured by means of the last suture.

After-treatment.—The scrotum is well slung up by a light roll of loose gauze applied as a suspender. This gauze elings to the skin better than any other dressing. The wound may be then dressed with a sponge dusted with iodoform, or with a pad of Tillmann's dressing packed all round with gauze, and secured by means of a T-bandage or a spica. If this be properly applied, the sponge or pad exerts firm but gentle pressure upon the wound. The drainage-tube should be removed in twenty-four hours, and the dry dressing continued.

In the first twenty-four hours after the operation retention of urine may exist.

The scrotum is easily inflamed by the use of irritant lotions—*e.g.* strong carbolic solutions.

Should suppuration occur, constant care must be taken to prevent bagging.

The sutures are removed on the fifth to the seventh day. The patient will probably complain of the hard tender swelling which usually appears at the external ring, and which is due to inflammatory changes in the stump of the cord.

As the wound heals, the cicatrix becomes depressed, from the obliteration of the scrotal pouch.

If primary union be not obtained, the edges of the wound may need to be retained in contact by strapping.

Comment.—In some cases the descent of a hernia after castration has forced open the wound, the rupture having been previously kept up by the enlarged testicle. During the operation, moreover, hernial sacs have been inadvertently opened up. If a scrotal hernia exists, the rupture should be reduced, the sac excised, and its neck ligatured. The procedure is described in the chapter on the Radical Cure of Hernia (page 549).

The skin incision should be carried to the bottom of the scrotum, in order to secure good drainage.

It may, however, be noted that the higher up the incision is placed, the more easy is it to avoid septic contamination, and that unless the testis is of great size, it is possible to remove it

through a moderate incision made near the external ring. The bottom of the scrotum may then be drained for twenty-four hours through a separate puncture.

When the skin is implicated by the disease, the incisions should extend beyond the diseased area, and involve sound skin only.

It is not necessary to remove redundant skin, unless it be excessive in amount and much atrophied.

If any sinuses be left behind, as after the removal of a tuberculous testis, they should be most carefully scraped with a Volkmann's spoon. The cord should be secured about one inch from the testis. If it be involved, it should be divided higher up. It can seldom be necessary to open up the whole inguinal canal to secure the cord, as advised by some. If the disease has extended to the external ring, the expediency of any operation may be questioned. Before the cord is secured and divided, the anæsthetic may be discontinued for a while, as the section is sometimes attended by a very marked and possibly alarming sinking of the pulse.

It is to be remembered that the cord is very much dragged down by a large growth; and if secured very high up, the stump, after section, may be withdrawn beyond easy reach when the heavy tumour is removed.

The chief bleeding to be feared after castration cases is venous rather than arterial.

It is unwise to include the cord in one ligature; the vessels are not well secured by this means. The loop of thread may slip off when the clamp is removed. A substantial ligature (if single) must be employed, and it is too apt to excite suppuration until it is discharged. Secondary hæmorrhage may follow the loosening of the single ligature. Neuralgia of the cord may also attend the procedure.

The same objections apply, but in a less degree, to the practice of transfixing the cord with a needle, and ligaturing it in two segments.

Sometimes a tuberculous or syphilitic testis has to be operated on in which suppuration has already supervened, and the parts are thoroughly septic. In such a case, although all possible

precautions are taken at the time of operation, the surgeon can hardly hope for primary union, and free provision for drainage should be made. In nearly all cases of tuberculous orchitis the vas is invaded with tubercle bacilli along its whole course by the time the patient consents to operation. Owing to this fact, a troublesome complication after simple castration is the development of a secondary lump or abscess round the severed end of the vas. This may occur weeks or months after the wound has apparently healed.

Partly to avoid this, and also to make a complete clearance of all the tuberculous disease, the plan has been carried out of removing the lower end of the vas and the corresponding vesicula seminalis by the perineal route, whilst the other end is pulled away with the testis through an incision prolonged into the inguinal canal. Reverdin and other surgeons have proved that it is thus possible to remove the whole length of the vas, but the proceeding is one of considerable difficulty and of very doubtful value. The perineal part of the operation, conducted through a curved incision made in front of the rectum and across the median raphe, is similar to and even more difficult than perineal prostatectomy. The vas and vesicula have to be reached at the bottom of a deep and narrow wound, there is apt to be most troublesome venous hæmorrhage, and there is some risk of damaging the bladder wall (to which the vesicula is closely bound by the recto-vesical fascia) or the ureter. Finally, the wound is placed very badly for aseptic purposes. To drag the greater part of the vas deferens out through the inguinal canal is also a rough and hazardous procedure. When it is added that tuberculous disease of the vesical neck or prostate is often present at the same time as the disease of the vas deferens, and that spontaneous recovery from both is not infrequent, the arguments in favour of combined perineal and inguinal operations are seen to be but feeble. The operation was described in the *Gazette des Hôpitaux*, October 15, 1898, and also in the *Bull. de la Soc. Anatomique*, 1898, p. 603.

Erasion of the Tuberculous Epididymis.—In removing the whole organ the surgeon is often taking away much more than is actually diseased, for in the majority of cases the testis

proper will be found to be free from tubercle. It is the epididymis and the vas which are involved with so-called "crude tubercle," whilst occasionally the testis becomes affected with miliary deposit. Hence a very thorough erasion and excision of all the tuberculous foci will often suffice, and the testis itself may be safely retained. We have known cases in which the whole epididymis and several inches of diseased vas deferens were excised, the testis remaining for years of normal consistence and size. Some importance is to be attached to the retention of the "internal secretion" of the testis.

The erasion must be effected through a free incision, the testis being turned out and the tunica vaginalis being laid open. Every particle of tuberculous tissue should be cut or scraped away, and if the vas is diseased, it also should be dealt with. Care should be taken not to damage the main vessels of the cord, and if this be avoided, the hæmorrhage will only be slight. Finally, the testis and its vessels are replaced in the scrotum, and a small drainage-tube left in the wound for a few days.

CHAPTER IV.

AMPUTATION OF THE PENIS.

THIS operation is required principally for cases of epithelioma. The disease commences almost invariably on the glans or the inner surface of the prepuce, and leads to secondary deposits in the inguinal glands before either the corpus spongiosum or the corpora cavernosa are much involved. Hence, as a rule, amputation of the free portion of the penis, leaving a stump of the organ, with simultaneous removal of any inguinal glands that are abnormally large or hard, should be the operation of choice. A method of removing the entire organ, including the whole of the corpora cavernosa, will be described ; but it should be understood that not only is it rarely required, but that it affords a greatly inferior result so far as the patient's comfort and the risk of stricture are concerned.

Epithelioma of the penis is a purely local form of cancer, and the results of early operation are most satisfactory as regards prospect of cure. It is a mistake to suppose that the disease tends rapidly to spread backwards along the urethra or the cavernous tissue of the organ.

With regard to its amputation, the following points must be attended to :—

1. The stump should be provided with a flap of skin from the dorsum, and primary union secured as carefully as in amputating a limb. All methods involving the use of an *écraseur* or cautery should be entirely abandoned, and hence need not here be described.
2. An elastic tourniquet should always be used, and the vessels likely to bleed should be carefully ligatured

before it is removed. These vessels are two dorsal arteries, on either side of the dorsal vein, an artery in the centre of each corpus cavernosum, two small ones in the corpus spongiosum, and two or more veins in the subcutaneous layer. Their position is shown in the diagram from Testut (page 664).

3. The corpus spongiosum must be divided at least half an inch further forwards than the corpora cavernosa. The end of the urethra must be brought through an aperture in the dorsal flap, notched and sutured with the mucous membrane everted so that there is no risk of a stricture ensuing. This most troublesome result was common after amputation of the penis, but in a long series of cases operated on by us of late years, the only one in which stricture followed was one in which the Thiersch-Gould method was employed. In this case the perineal meatus had narrowed to pin-point dimensions in the course of a year, and a fresh operation had to be performed.

Instruments Required.—For the operations to be described, the following instruments are needed:—An elastic band tourniquet; hare-lip pins; a gum-elastic catheter; a scalpel; a narrow straight bistoury; straight and curved scissors; a tenaculum; dissecting, toothed, and artery forceps; small curved needles and needle-holder for the urethra; straight needles; a periosteal elevator; sutures; ligatures.

Amputation of the Free Portion of the Penis by Dorsal Flap.—The hair about the root of the penis having been shaved off, the parts are rendered as aseptic as possible in the usual way. The patient lies in the usual position, with the thighs slightly abducted; the surgeon stands on the right side of the patient. Previous to the operation the rectum and bladder should have been emptied. An elastic tourniquet—a No. 9 soft rubber catheter answers admirably—is tied around the root of the penis. The tourniquet may be prevented from slipping forward by applying it behind a sterilised hare-lip pin used to transfix the penis.

The end of the penis is then held by an assistant with forceps, and a rounded dorsal flap of skin and fascia shaped out and dissected up. This flap must be of sufficient dimensions to cover the whole section of the penis, and it should be made well behind the edge of the epithelioma. The flap being held back, the penis is transfixed with a narrow-bladed sharp bistoury between the corpus spongiosum and the corpora cavernosa. In

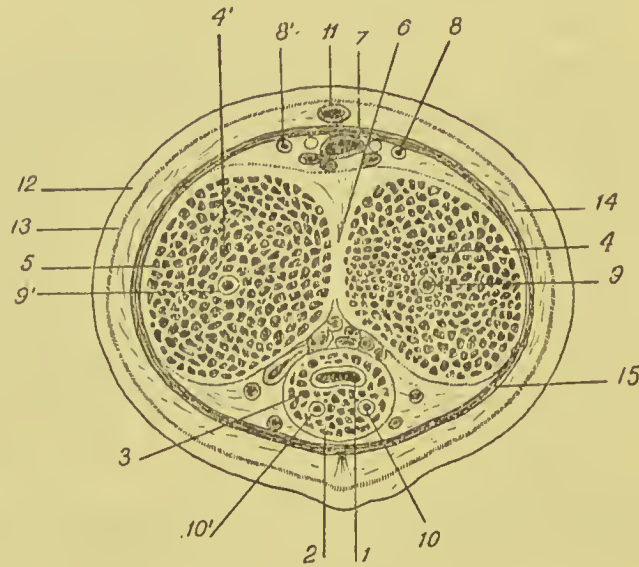


Fig. 450.—SECTION OF PENIS SHOWING THE VESSELS REQUIRING LIGATURE IN AMPUTATION THROUGH THE ORGAN. (*From Testut's Anatomy.*)

- 1, Urethra; 2 and 3, Corpus spongiosum; 4 and 5, Corpus cavernosum; 6, Median septum; 7, Dorsal vein; 8 and 8', Dorsal arteries; 9 and 9', Artery of corpus cavernosum; 10 and 10', Arteries of corpus spongiosum; 11, Additional dorsal vein beneath skin; 12, Skin of penis; 13, Dartos layer; 14, Cellular tissue; 15, Fascial sheath.

order to guard against the risk of injuring the roof of the urethra with the knife, it is well to have introduced a catheter before transfixion. The blade of the knife is then turned upwards, and the two corpora cavernosa are divided at the level of the base of the skin flap.

The urethra is now dissected out for nearly an inch in front of the point where the knife was introduced, and severed at this level. The skin on the under-surface of the penis is divided transversely from one end of the dorsal incision to the other. There has been hitherto no hæmorrhage, and before removing

the tourniquet, all the chief arteries and veins are carefully secured with catgut ligatures. The tourniquet is now removed, and any bleeding points are dealt with.

A small incision is made through the dorsal flap, and the stump of the urethra drawn through this opening; the end of the urethra is notched on both sides, so that it can be everted and sutured all round to the margin of the opening in the flap. The edges of the latter and of the skin below are then sutured. Either fine silk or catgut may be used—the latter has the advantage of not requiring subsequent removal. It is difficult to keep any dressing applied, and none is really required. Some boracic and iodoform powder may be dusted on. It is well to leave the ends of two of the sutures which secure the new meatus long, as they facilitate the passage of a catheter during the next day or two. However, as a rule, the patient will be able to pass his urine without an instrument. It will be seen that by this method no raw surface is left, requiring slow cicatrisation with its attendant risk of stricture. Healing is therefore rapid, and the patient need not be kept in bed for more than a week or so. One point in the operation is of special importance: to take plenty of time in securing all bleeding vessels before the flap is sewn down. The use of the tourniquet is essential. If any lymphatic glands in either groin are enlarged, they should be excised at the same time as the amputation of the penis. This is done through an oblique incision on one or both sides, the cut running parallel to Poupart's ligament.

Amputation of the Entire Penis.—The best procedure for the removal of the entire penis is that devised by Prof. Thiersch and Mr. Pearce Gould (*Lancet*, vol. i., 1882, page 821). It ensures a very complete removal of the diseased organ. The new opening of the urethra is well established. There is no risk of an infiltration of urine into the tissues of the scrotum, and the skin of the part is not irritated by the trickling of urine over it.

The Operation is performed as follows:—

The patient having been placed in the lithotomy position, the skin of the scrotum is incised along the whole length of the raphe. With the finger and the handle of the scalpel the

two halves of the scrotum are then separated, quite down to the corpus spongiosum. A full-sized metal catheter is now passed as far as the triangular ligament, and the knife is inserted transversely between the corpora cavernosa and the corpus spongiosum.

The catheter having been withdrawn, the urethra is cut across. The deep end of the urethra is then detached from the penis quite back to the triangular ligament. An incision is next made round the root of the penis, continuous with that in the median line; the suspensory ligament is divided, and the penis separated, except at the attachment of the crura. The knife is now laid aside, and with a stout periosteal elevator, or rugine, each crus is detached from the pubic arch. This step of the operation involves some time, on account of the very firm union of the parts to be severed. Four arteries—the two arteries of the corpora cavernosa and the two dorsal arteries—require ligature.

The corpus spongiosum is slit up for about half an inch, and the edges of the cut are stitched to the back part of the incision in the scrotum.

The serotal incision is closed by sutures, and a drainage-tube is so placed in the deep part of the wound that its ends can be brought out in front and behind. No catheter is retained in the urethra.

This operation has been combined with double castration by some surgeons. In ordinary cases of epithelioma these extensive operations are not justifiable; they involve needless mutilation. The tendency of epithelioma to spread backwards along the crura penis is very small in comparison with the frequency of secondary deposits in the inguinal lymphatic glands.

CHAPTER V.

OPERATIVE TREATMENT OF SCROTAL ELEPHANTIASIS.

THE question of operation in cases of elephantiasis of the penis and scrotum is admirably discussed by Dr. McLeod, of Calcutta, in Heath's "Dictionary of Surgery" (vol. ii., page 399).

Mere bulk is no bar to operation, as tumours weighing 100 to 120 lbs. have been removed with success.

The following are the chief contra-indications to operation : old age ; organic disease of the heart, kidneys, or intestines ; anæmia ; diabetes ; recent and acute enlargements of the liver or spleen ; incurable urethral fistulæ ; the existence of large herniæ.

Before the operation any stricture of the urethra should be relieved, and abscesses and sinuses cured.

The main points in the operation are—rapid execution, the removal of every trace of the disease, the prevention of bleeding, the preservation of the essential parts of the organs of generation, and the encouragement of rapid healing.

The Operation is thus described by Dr. McLeod :—

The patient is placed in the recumbent posture and anæsthetised. To render the tumour anæmic, the mass is elevated and compressed by an elastic bandage for ten to twenty minutes, according to the size of the mass.

To prevent bleeding during the operation, an elastic cord about three feet long is taken, and the centre of it is passed round the loins, the ends are brought over the brim of the pelvis, are crossed twice over opposite sides of the neck of the tumour, and finally are brought together below the navel. The neck of the tumour will thus be tightly embraced by two turns of the

cord on each side, crossing each other on the pubes, and just in front of the anus.

No portion of diseased tissue must be left behind. Even although the prepuce appears to be healthy, it should be removed close to the corona; and as thickening is peculiarly apt to commence in the raphe of the perineum, that part should, in most cases, be freely removed by a V-shaped incision up to the verge of the anus. If any attempt is made to cover the penis and testes with flaps, these should be taken from the skin of the abdomen or thighs, and not from the neck of the tumour; but a satisfactory result can be secured in all cases without resort to flaps, which are prone to slough and suppurate.

The first step consists in decorticating the penis. The prepuce is slit up, and a skin incision continued from this slit along the whole dorsum of the penis to the root. The penis is then freed by finger and knife, the mucous membrane of the prepuce being carefully detached at the line of its reflexion. The isolation of the penis is completed as far as its suspensory ligament, which should not be injured. A vertical incision is now made from the pubes to the fundus of the tumour, over one cord and testis. By successive bold strokes these are exposed, and then dissected out by fingers and knife, and subsequently held out of the way by an assistant. The other testis is similarly dealt with. The three vertical incisions are then connected at their pubic terminations by two transverse cuts, which must be beyond the limit of the diseased tissue.

A circular or oval incision is now made round the rest of the circumference of the neck of the tumour, and by rapid strokes the whole mass is removed. Vessels are now looked for. The largest will be found in the centre of the perineum and on each side of the pubes. By gradually loosening the cord, others will be observed to spring. As many as thirty or forty ligatures may be required. The parts may now be trimmed, if any diseased tissue has been left behind. The testes may next be stitched together by means of catgut, and fastened in proper position by sutures of the same material. Depressions or pockets can be very easily made for their reception, by separating the deep layer of the superficial perineal fascia from the subjacent

fat and areolar tissue. The skin can then be drawn over them from each side to a considerable extent by means of a continuous catgut suture.

The prevention of putrefaction in such an extensive wound is difficult. Free and frequent irrigations and careful drainage must be persisted in. Dr. McLeod is in favour of the use of boracic dressings.

The wound fills up by granulation, and the process of repair occupies from six weeks to two months. Care must be taken to keep the penis free, as it is apt to become embedded in the mass of granulation tissue. The ultimate result of the operation is in the great majority of cases satisfactory. Skin is dragged by the process of cicatrisation from the thigh to form a seemly substitute for the scrotum, and the penis acquires a fresh covering of epidermis. The sexual functions are restored, and both health and comfort re-established.

If the skin of the penis is quite healthy, the scrotum may be removed alone by a circular incision round its neck, the testes being dissected out as the incision is deepened.

CHAPTER VI.

CIRCUMCISION.

IN performing the operation for a redundant prepuce, the following method will be found convenient:--

The end of the penis is lightly seized with a pair of circumcision forceps or dressing forceps. The forceps are so applied that their lower margins fall exactly across the line of the corona. As the blades are closed the glans slips out of the way, and at last nothing is held but the prepuce. The size of forceps employed must vary with the age of the patient. They should hold the skin firmly and squarely:

As the glans slips out of the grip of the forceps, the skin at the orifice of the prepuce may become turned in, and too much of the integument of the penis be drawn between the blades of the instrument. To avoid this, the foreskin should be firmly held with a pair of sharp-toothed forceps, which are applied at the preputial orifice, exactly where the skin and mucous membrane join. They serve to keep the prepuce in position while the clamp forceps are acquiring a hold. As already stated, the latter are applied exactly along the line of the corona; they will thus, when fixed, be obliquely placed with reference to the long axis of the penis.

More skin is removed from the dorsal than the frænal aspect of the part. To ensure a most correct adjustment of the forceps, an ink mark may be made on the skin of the penis, precisely around the line of the corona, as the parts lie before being disturbed. When the blades are closed, this ink line should not be visible beyond them. In infants forceps are not required, the prepuce being grasped by the thumb and forefinger.

The skin being now put upon the stretch by drawing on

the forceps (if forceps are used), the prepuce is divided with a fine straight bistoury just beyond the forceps blades—*i.e.* on the distal side of the latter.

The mucous layer left behind is now slit up along the dorsal median line. This is best done with straight scissors, while the membrane is held with toothed forceps. The slit must go well back to the corona. The two flaps of mucous membrane are now stripped off the glans until the corona is reached. The membrane is often very adherent, and has to be forcibly peeled off by forceps and a director. Any collection of smegma preputii is removed. The edges of the mucous flaps may be trimmed, and then allowed to fall over on to the cut skin surface. In infants no sutures are required; and as no bleeding points will require attention, the operation is complete. In lads and adults the cut edges of the mucous membrane and skin must be united by sutures. The finest catgut should be employed, and should be inserted as close as possible to the free margins of both the skin and the mucous membrane. If this is done, the sutures will cut their way out, and need not be removed unless they are still retained on the seventh day. Not more than three suture points on each side will be required.

In adults there may be free bleeding, and a vessel or so may have to be secured. It is the arteries on either side of the frænum that have caused troublesome secondary hæmorrhage after circumcision.

The wound is best dressed by a narrow strip of quite dry lint dusted with iodoform, and secured around the penis.

A strip of dry cyanide gauze wound several times round and secured by celloidin or collodion answers equally well. Of course the fixative must not be applied over the whole of the gauze, as its contraction would cause trouble.

By the use of the dry dressing oozing is checked; and as the lint sticks to the part, the wound edges are kept in contact. Oiled dressings of any kind are objectionable. The dressing slips about, and is very apt to come off:

The first dressing is left untouched for twenty-four or thirty hours; it is then allowed to soak off as the patient sits in a warm hip-bath.

Dry lint and iodoform make, I think, the best dressing throughout the case. The patient—if an adult—should remain in the recumbent position for two or three days, and should not move about much until the part is nearly healed. He should have a warm hip-bath on the third or fourth day, and after that, if possible, every night and morning. On each occasion the wound is re-dressed.

It is important that no tight band should surround the penis, since the extremity may become congested and œdematous. As the patient lies in bed, the penis must be kept supported, and not allowed to hang down. A cradle will be required. In infants, the following method of dressing the wound—as proposed by Paul Swain—will be found very convenient (Heath's "Dictionary of Surgery," vol. i., page 308):—

"A long strip of dry lint, six or eight inches long and half an inch wide, is applied as follows:—The glans being well pulled forward by an assistant, the middle of the strip of lint is applied to the under-surface of the penis, immediately behind the glans. The two ends are then passed over and around the organ in successive turns until the root is reached, when they will lie crossed on the lower part of the abdomen, and must be secured in that position by a couple of strips of adhesive plaster. The orifice of the urethra is thus left free, the cut edges of the mucous membrane and skin are retained in apposition, and the child is unable to pull off the dressings."

Often a good deal of thickening remains about the frænum, and there may result therefrom a permanent lump. This is entirely due to the leaving of too much tissue about the frænum. It is to a great extent avoided if the wound line faithfully follow the corona. It is a common mistake to divide the prepuce in a line at right angles to the long axis of the penis.

In adults, where the preputial orifice is very narrow, but the foreskin itself is not unduly redundant, nothing requires to be cut away. A director is thrust under the prepuce, and carried well back to the corona. A narrow curved bistoury with a sharp point is made to follow the director, and the point to pierce the skin at the level of the corona. The foreskin is thus slit up along the median dorsal line. The mucous

membrane is peeled back, the two flaps are rounded off, and the cut edges are united by a few suture points, as in the more complete operation.

Local anæsthesia by means of eucaine or cocaine injections answers perfectly for circumcision in adults. An elastic tourniquet should always be used under these circumstances, since it prevents risk of toxic absorption. The solution used need not be stronger than 1 or 2 per cent.

Part XIII.

OPERATIONS UPON THE RECTUM.

CHAPTER I.

OPERATIVE TREATMENT OF HÆMORRHOIDS.

Anatomy of the Rectum.—The length of the rectum is estimated at about eight inches. Its upper part for about three inches is entirely invested by peritoneum. The serous membrane gradually leaves its posterior surface, then its sides, and lastly its anterior surface. Anteriorly, the peritoneum, in the form of the recto-vesical pouch, extends in the male to within about three inches of the anus. This distance is lessened when the bladder and rectum are both empty, and is increased when they are distended. On the posterior surface of the gut there is no peritoneum below a spot five inches from the anus.

Below the point where the serous membrane ceases, the rectum is connected to surrounding parts by areolar tissue. It is in close relation behind with the sacrum and coccyx, at the sides with the levatores ani, and in front (in the male) with the trigone of the bladder, the seminal vesicles, and the prostate. Below the prostate the rectum becomes invested by the internal sphincter, and is embraced by the levatores ani muscles. In the female the lower part of the rectum is firmly attached to the posterior wall of the vagina.

The internal sphincter surrounds the lower part of the rectum an inch above the anus, and extends over about half an inch of the intestine.

The posterior edge of the levator ani muscle forms a

distinct free border, which crosses the rectum, at very nearly a right angle, at a point from one and a half to two inches from the anus, and therefore above the upper limit of the sphincter ani.

Of the arteries of the rectum, the most important is the superior hæmorrhoidal. It runs down behind the rectum, lying slightly to the left of the median line, and breaks up into its terminal branches about four or four and a half inches from the anus. (*See Fig. 454, page 708.*)

Over the lower part of the rectum—the last four inches—the arteries are arranged as follows:—"The vessels, having penetrated the muscular coat at different heights, assume a longitudinal direction, passing in parallel lines towards the end of the bowel. In their progress downwards they communicate with one another at intervals, and they are very freely connected near the orifice, where all the arteries join by branches of considerable size" (R. Quain). This longitudinal arrangement of the arteries explains the fact that when the rectum is incised in the line of its long axis, the bleeding is comparatively slight; while it is copious if the bowel be divided transversely.

The fact that the lower part of the rectum is mainly supplied by these vertical branches which descend in the coats of the bowel, explains the comparatively slight bleeding that attends the separation of the gut from its lateral connections in the operation of excision.

The veins have an arrangement closely resembling that of the arteries. For the first three inches or so beyond the anus they run between the mucous and muscular coats, and then, perforating the muscular tunic, pass up externally to the bowel.

OPERATIVE TREATMENT OF HÆMORRHOIDS.

The operative measures which have been from time to time proposed or carried out in the treatment of hæmorrhoids are legion. In few departments of surgery has there been a more remarkable or a more restless activity.

Among the numerous operations which are at the present time employed, a certain number do not call for description in

a work like the present. Such are the treatment by caustics and acids, the injection of carbolic acid or other fluids, the puncture of the pile with a fine cautery point, the treatment by dilatation of the sphincter, as advocated by Verneuil, and the employment of electrolysis. Not one of these methods is satisfactory or trustworthy.

The following operative measures will be here described :—

1. Treatment by ligature.
2. Treatment by excision.
3. Treatment by crushing.
4. Treatment by the cautery.

Preparation of the Patient.—A few days' rest before an operation for piles is carried out is very desirable, although it is not often afforded. During these few days the patient should limit himself to a very simple and moderate diet, should avoid stimulants, and should attend to the action of the bowels. The man who is working hard and living "well" up to the very eve of the operation, and who concludes the preliminary treatment with a "good" dinner, on the plea that it will be some time before he will have another such repast, is not a good subject for operation.

The bowels must be well opened by an aperient—preferably castor oil—administered thirty-six hours before the operation is performed. Just before the surgeon's arrival the rectum should be thoroughly cleared out by a warm water enema, and the nurse should be careful to see that all the fluid injected is returned. A hot bath should be taken on the evening before the operation.

Instruments Required. — *Ligature Operation.* — Clover's crutch; pile-holding forceps (there are many forms of these forceps—some resemble the volsella, others are constructed on the principle of the pressure forceps, and another series follows the mechanism of artery torsion forceps, and is provided with a sliding catch—it is desirable that the instrument should be self-holding); scissors—sharp and blunt-pointed, straight, and curved on the flat (special forms of hæmorrhoid scissors, such as the well-known scissors or shears introduced by Salmon are not specially convenient); pressure and artery forceps; silk.

Excision Operation.—The same instruments, with the addition of dissecting forceps, volsella, needles and needle-holders, scalpel, catgut ligatures, sponges in holders. A rectal speculum may be of use.

The Operation by Crushing.—In addition to the chief instruments already mentioned, a special crushing clamp is required; and in the *Treatment by the Cautery*, Smith's clamp and Paquelin's cautery are needed.

1. Operation by Ligature.—The patient is anæsthetised, Clover's crutch is applied, and the patient is placed in the lithotomy position, the buttocks being brought close to the lower end of the table. The surgeon sits facing the perineum.

The first step consists in dilating the sphincters. Both index fingers are introduced, and the anus is slowly and gradually stretched. The process will require at least two minutes to accomplish, and when complete the anus will be patulous, and the sphincter will have lost its tendency to contract. If a hasty dilatation be effected, the sphincter may relax suddenly, and a laceration of the parts be brought about. The surgeon should maintain a watchful control over the dilating fingers.

The parts are now in a convenient condition for operation. The piles, which may previously have been entirely withdrawn from view, are now readily exposed, and the whole of the lower part of the rectum can be inspected and explored. The surgeon, after a careful examination of the district, should decide on the number of piles which may require removal.

It is desirable to commence with the hæmorrhoids on the lower or posterior wall of the rectum, since, when the piles on the opposite wall are being dealt with, these are obscured by the blood. Small piles, which are evident enough before the actual operation is commenced, may be lost sight of after some of the main ligatures have been applied. As a preliminary step, it is well to seize each of these smaller excrescences with pressure forceps, which are left in position, as a guide to the site of the pile, until the surgeon finds it convenient to deal with them. These forceps hang loose, and are not in the way.

Each pile is seized with the pile-holding forceps, held in

the left hand, and is gently drawn away from the anus and towards the middle line. Its base is thus rendered tense, and the line of junction of the skin with the mucous membrane is brought well into view.

By a series of snips with the scissors the surgeon severs all the *lower* attachments of the pile, cutting along the line of junction of the skin and mucous membrane.

By a few light snips, aided with a little pressure from the blunt points of the scissors, the pile is dissected up from the submucous tissue until it is attached only by the healthy mucous membrane above it, and by the vessels that are descending to enter it. As the vessels come from above and run just beneath the mucous membrane, and enter the upper part of the hæmorrhoid, this detachment is readily and safely accomplished, and the bleeding is very trivial.

The detachment should be sufficiently extensive to form a deep groove.

The forceps are now handed to an attendant, who maintains the traction upon the pile, while the surgeon places a silk ligature round its pedicle, which he at once proceeds to tie as tightly as possible.

The ligature should not be too thick, and it should not be applied with such violence as to cut the pedicle of the pile entirely through. Before tightening the knot, the ligature should be so manipulated as to include the highest part of the mucous membrane left attached to the pile.

There are two points to be specially attended to in applying the ligatures. The groove in which each lies must be made within the margin of the external sphincter, so that the ligature includes no part of the muscle. Secondly, there must be no risk of the ligature slipping after the stump has been returned, for most troublesome hæmorrhage may then result. The tighter it is tied the better, and a third knot should be made for security. The scissors should not be applied too closely to the ligatures.

The number of ligatures to be applied will of course vary. More than five will seldom be required.

The operation is completed by cutting the ligatures off, and by snipping away about two-thirds of the strangulated

hæmorrhoidal tissues which project beyond the knot. The parts are lightly dried and returned within the sphincter.

A soft pad of moistened gauze, over which is a square pad of absorbent wool, is then secured in place by a firm T-bandage. It is customary to insert a suppository containing a quarter to half a grain of morphia within the rectum before applying the dressing.

When the hæmorrhoids form a complete circle within the anus, the most prominent portions must be isolated by means of incisions made through the mucous membrane; and when the pile mass has thus been divided into segments, each part is ligatured separately.

This method of employing the ligature is that introduced by Salmon at St. Mark's Hospital.

Some surgeons prefer that the patient should lie during the operation upon one side, with the knees well drawn up.

The plan of drawing forward a pile and of transfixing its pedicle with a needle in a handle carrying a ligature, and of then securing the pile in two parts, is to be condemned. A great deal more tissue is taken up than is necessary, the vein in the excrescence may be transfixed by the needle, bleeding may follow, and risk of septic infection is incurred.

2. The Operation by Excision.—Of the various methods of treating piles by excision which have been from time to time employed, the most precise, and probably the most successful, is that introduced by Mr. Walter Whitehead (*Brit. Med. Journ.*, February, 1882, and February, 1887). The operation is carried out on sound surgical principles, and has been attended with considerable success.

The patient is secured in the lithotomy position by Clover's crutch, and the sphincters are fully dilated. "By the use of scissors and dissecting forceps the mucous membrane is divided at its junction with the skin round the entire circumference of the bowel, every irregularity of the skin being carefully followed. The external, and the commencement of the internal sphincters are then exposed by a rapid dissection, and the mucous membrane and attached hæmorrhoids, thus separated from the submucous bed on which they rested, are pulled bodily

down, any undivided points of resistance being nipped across, and the hæmorrhoids brought below the margin of the skin.

“The mucous membrane above the hæmorrhoids is now divided transversely in successive stages, and the free margin of the severed membrane above is attached as soon as divided to the free margin of the skin below by a suitable number of sutures” (*Brit. Med. Journ.*, February 26, 1887, page 449).

In this way the complete ring of pile-bearing mucous membrane is removed. All bleeding vessels encountered throughout the operation are treated by torsion. As a rule, only one or two need torsion.

The separation of the mucous membrane is accomplished with the fingers and the end of a pair of blunt-pointed scissors.

The sutures employed are of carbolised silk, and are allowed to come away of themselves.

In the paper from which the above quotation is made Mr. Whitehead reports 300 consecutive cases of hæmorrhoids which he has treated by excision alone, without a death, without a single case of secondary hæmorrhage, and without any instance of complication or relapse.

Details of the Operation by Excision (Fig. 451).—In all instances in which the hæmorrhoids have been extensive I have employed this method exclusively for many years past. The following is the procedure I adopt. The patient is secured in the lithotomy position by means of Clover’s crutch. The perineum is shaved if necessary. The sphincters are very thoroughly dilated, and the piles are made to protrude completely. As blood soon obscures the view, it is best to commence the operation at the lowest point of the anal margin, then to proceed to the sides, and finally to the upper margin. By means of a short, sharp scalpel the mucous membrane is divided at its exact point of junction with the skin around the entire circumference of the anus. All the inequalities of the surface are followed, and in places where the skin is distinctly redundant a variable amount of integument is included in the part to be removed—*i.e.* in such places the knife travels a little away from the mucous membrane. Two assistants are present, who stand one on either side of the operator. As soon as the above

incision is completed, pressure forceps are attached to the margins of the cut skin at four equidistant parts, which may be referred to as north, south, east, and west of the anal orifice. Pressure forceps are also attached to corresponding points on the margin of the divided mucous membrane. By drawing in opposite directions any two companion forceps, the separation of the mucous membrane at that point is much assisted.

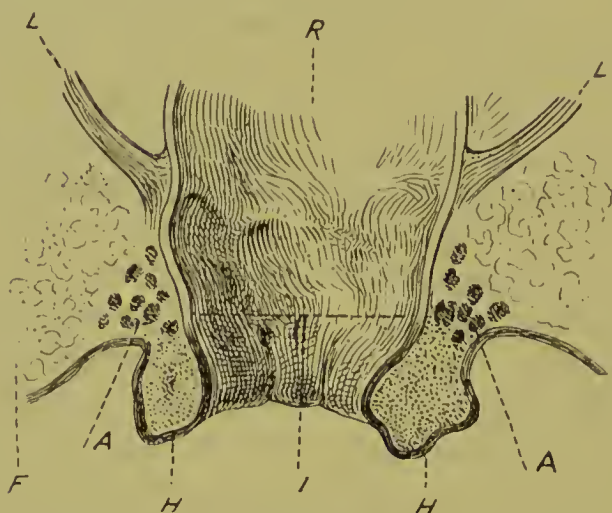


Fig. 451.—TRANSVERSE VERTICAL SECTION THROUGH RECTUM, THE SITE OF MARGINAL HÆMORRHOIDS (H).

LL, Levator ani; AA, Sphincter ani externus; F, Fat in ischio-rectal fossa. The dotted line I shows the level at which the mucous membrane should be divided in Whitehead's operation; the point at which the dotted line running up from AA crosses the perianal skin indicates the line at which the latter should be divided.

The circular incision is gradually deepened, most conveniently with blunt-pointed straight scissors aided by forceps. The separation of skin and mucous membrane is carried out until the external sphincter is recognised. Its most external fibres are indistinct, but there is very little difficulty in soon demonstrating its form as a circular band of muscle, which is carefully preserved. As soon as the external sphincter is cleared, the separation of the mucous membrane becomes easy.

The surgeon must remember that the operation consists in the excision of an unbroken circle of mucous membrane and submucous tissue containing veins, and of nothing else.

The separation of this ring or tube of mucous membrane is readily accomplished by the blunt point of the scissors, aided by the finger, and at every step assisted by traction upon the forceps, which are fixed to the cut edge of the mucous membrane. To aid such traction, additional forceps (in excess of the four already in use) may be attached to the mucous membrane where needed. The tube of mucous membrane must be well and evenly isolated all round, and the separation must be continued up to a point at least half an inch above the intended line of section. The internal sphincter is in no way disturbed. Up to this point the bleeding is trifling, and any vessels which give trouble are seized with pressure forceps and dealt with by torsion.

The surgeon now proceeds to cut through the isolated tube of mucous membrane, which includes all the piles and, indeed, all the pile-bearing district. He introduces the forefinger of the left hand into the mucous tube, and divides it in a circular line, which is at right angles to the long axis of the rectum. He makes the division bit by bit, while an assistant draws upon the forceps which have been fixed to the anal edge of the mucous membrane. As each vessel is divided, it is secured by pressure forceps. A little experience will teach the operator where the vessels lie, so that their division is not made unexpectedly. In due course the involved mucous membrane (with the original forceps still attached) is entirely removed as an unbroken ring or tube. There then remains the divided line of skin with the original forceps still attached, and the divided line of mucous membrane, to which some six to ten forceps, securing vessels, will be attached.

The sutures are now ready to be applied. The best suture material is fine chromicised catgut used absolutely dry. The suture is of good length, and is carried in a curved needle held in a Hagedorn's needle-holder. The surgeon passes the needle through the edge of the divided skin, and then, taking up in his left hand one of the forceps affixed to the mucous membrane (and also grasping a cut vessel), he passes the needle through the mucous membrane in such a way as to take up the vessel in question. He then removes the forceps and ties the ligature

in a firm surgeon's knot. Thus the cut edges of the skin and mucous membrane are brought together, and the divided vessel in the latter membrane is secured by being as it were underpinned by the single suture. In this way the wound is closed all round. From ten to twenty sutures will be required. No vessel needs to be ligatured, nor even to be twisted. The suture controls each one quite perfectly. Additional sutures are applied where required. The suture involves only the skin, the mucous membrane, and the vessel in the submucous tissue. The sphincter is excluded entirely from it.

The wound, after union, looks irregular and untidy, but it soon assumes a regular outline. The parts are dried, are dusted with iodoform if considered desirable, and are well and firmly supported by a dry pad of wool held in place by a stout T-bandage. This pad need not be disturbed for forty-eight hours. The catgut sutures are not touched. They are allowed to work out in due course. I have performed this operation in some hundreds of cases without a death, without any after-bleeding, and without any deep suppuration.

The pain after the operation is slight. In a few instances I have met with a trifling linear contraction at the exact skin margin of the anus. This has never given any real trouble, and has always yielded to the passing of a bougie daily for a few days.

3. The Operation by Crushing.—The treatment of piles by crushing was introduced by Mr. George Pollock (*Lancet*, July 3, 1880). The operation has been advocated by Mr. Allingham and others.

Of the many pile-crushers devised, the most convenient is that known as Allingham's (Fig. 452).

The patient having been placed in position, and the sphincter dilated (*see* page 678), a pair of pile-holding forceps is passed through the open square of the crusher, a pile is seized with the forceps, and is then drawn into the crusher, the blade of which is at once screwed down. The instrument should be screwed up as tightly as possible, and should be left in place for a minute or two. The portion of the pile projecting beyond the clamp is then either cut away or destroyed by the cautery. The clamp is now slowly unscrewed and removed, and it will

usually be found that no bleeding follows. Any bleeding vessel may be secured by a ligature or be twisted. Care must be taken not to include any skin in the crusher.

4. **The Operation by the Cautery.**—The method of treating piles by means of the actual cautery is of very ancient date. The elaboration of the present means of employing the cautery is due to Mr. Lee and Mr. Henry Smith, both of whom devised special clamps for holding the pile and limiting the action of the heated iron.

The best clamp is that invented by the latter surgeon.

The patient having been placed in position, and the sphincter having been dilated as above described (page 678), each pile is seized in turn, and is drawn between the blades of the clamp, which are then screwed tightly together. The part of the pile projecting beyond the clamp is then cut off with blunt-pointed scissors curved on the flat, and the stump, which should be at least one-eighth of an inch in depth, is well charred with the Paquelin cautery. The cautery point should

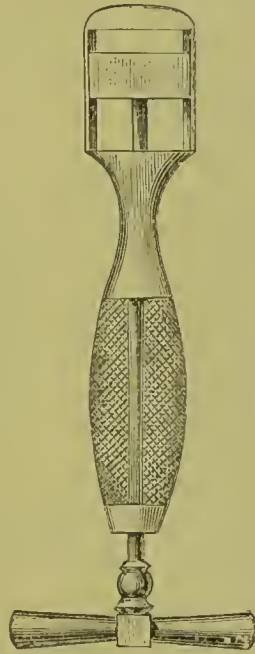


Fig. 452.—ALLINGHAM'S PILE-CRUSHER.

be heated only to a dull-red heat; the clamp is slowly relaxed, and the surgeon follows with the cautery point the charred tissues as they slip out between the blades. Bleeding very seldom occurs. It is well to attempt the thorough charring of the stump at the first application; if the burning be imperfect there may be a little oozing. The parts must not be roughly manipulated after the clamp has been removed, as the eschars are readily detached.

Comment.—Out of the operations above described it would be impossible to select one as the best if it were attempted to found the selection upon the writings of those surgeons who have more especially concerned themselves with this branch of surgery. Each operation has its own vigorous advocate, and in the hands of these special pleaders such excellent results are obtained as to make a safe criticism difficult.

Personally, I would share the opinion expressed by many, that the ligature offers on the whole the best means of dealing with single or isolated internal piles. It is simple and of wide application. It involves the employment of no complex instruments. It is but very rarely attended by secondary hæmorrhage, and its results are certain.

When the hæmorrhoids, however, are extensive, and especially when they involve the whole of the circumference of the anus, then there is no better method of dealing with them than is provided by Whitehead's operation, or the operation by excision. The operation by crushing is a little crude, and is of limited application. I cannot see that it possesses any particular advantage. As to the question of the comparative amount of after-pain in these various procedures, I am distinctly of opinion that the least pain attends the operation by excision. The pain noted after this measure is usually quite trifling.

For the operation by excision it may certainly be claimed that it is attended by no relapses or recurrences, and this claim cannot be maintained for any other of the operations just described.

The after-treatment is perhaps a little more prolonged after the use of the ligature than after the use of any one of the other measures detailed.

The risk involved by operations for piles is quite trifling. The mortality would not exceed 1 in 1,000.

After-treatment.—After the stumps left by the operation have been returned, the parts should be well dried.

A pad of cotton-wool may be placed over the anus, and be fixed in position by a T-bandage. Or in the place of the pad and bandage, a "sanitary towel" may be worn.

The pad or the towel supports the part during coughing or vomiting, absorbs any blood which may escape from the anus, keeps the buttocks apart, and prevents the involuntary straining which is common after these operations.

The pad or the towel may be discarded in a few days.

A morphia suppository inserted at the time of the operation is of service, and is very usually employed. The suppository

may contain from a quarter to half a grain of the drug. A little opium at night-time is, moreover, always desirable *for the first few nights*. The patient is often troubled by violent spasms—apparently of the levatores ani—which may be relieved by opium, and by opium only.

The patient should retain strictly the recumbent position. The anus should be washed night and morning, and dried. In some cases the patient has derived most comfort from a wet pad soaked with warm boracic lotion, and pressed firmly against the anus.

It is well that the bowels should not act until the morning of the fourth or fifth day. A dose of castor oil or of any other suitable aperient may be given, and just before the bowels act it is well to inject into the rectum some two ounces of warm olive oil. This injection is most conveniently given by a glass syringe. Patients usually dread the first action of the bowels, and the use of a bed-pan gives substantial grounds for that dread. In private practice the following substitute for the uncomfortable bed-pan may be employed. The patient lies upon the left side with the knees drawn up towards the chin and the buttocks projecting beyond the edge of the bed. The buttocks are oiled, and beneath them is placed a very large—and, indeed, voluminous—pad of cotton-wool. Beneath this substantial pad is a macintosh sheet, which entirely protects the bed. The motion is passed into the cotton-wool receptacle, and the whole is removed in the macintosh sheet. If there are scybalous masses in the rectum—as is not unusual when much opium on the one hand and much milk on the other have been taken—they must be got rid of by enemata. I am of opinion that the less opium given and the less milk drunk after a pile operation the better. The ligatures usually come away about the sixth or seventh day, and at the same time the sloughs left by the crushing or cautery operations may be expected to be expelled.

After the fifth or sixth day the bowels should be made to act every day, an aperient being administered as often as required.

Until the bowels act, the patient should be limited to a

slop diet. Stimulants should be avoided, except in the case of the aged or feeble.

After the bowels have acted, the patient may commence with fish, and later with meat. A liberal allowance of fruit and of suitable vegetables will be found to be of service. In the matter of diet, the patient's own inclination and appetite are usually surer guides than certain arbitrary rules which are founded upon the tastes and powers of an abstract stomach. It is to be remembered that a "slop diet" promotes flatulence. I have already commented upon the too liberal use of milk after these operations.

It is impossible to indicate precisely the duration of the after-treatment. It will depend largely upon the extent of the operation and upon the disposition of the patient. In a case of average severity the patient will probably be moved on to a sofa on the tenth day, and will be up between the fourteenth and the eighteenth day. It is most undesirable to allow the patient to get up too soon. No one single factor in the management of the case is more likely to protract the recovery than is a too early "getting-up." Time is always a most important element in the management of operations for piles.

It is well to remember that on the second or third day after the operation some œdema of the anus is usually met with, and that this is apt to give the patient unnecessary alarm, and to induce a belief that the piles have "returned" in full force.

Undue irritation about the anus may usually be relieved by calomel ointment (calomel, $\mathfrak{z}\text{i}$; vaseline, $\mathfrak{z}\text{i}$).

The chief complications which may occur during the after-treatment are retention of urine, hæmorrhage, tedious ulceration, and contraction of the anus.

CHAPTER II.

OPERATIVE TREATMENT OF FISTULA.

The Varieties of Fistula in Ano are conveniently divided as follows :—(1) Complete, in which there are distinct external and internal openings. (2) Blind external, in which an external opening alone exists. In not a few of these cases there is an internal opening, but from its being very small or situated in an unexpected place, it is overlooked. (3) Blind internal, in which the internal opening alone exists, the skin being sound.

Both the openings are usually situated within an inch of the anus, and most commonly within half an inch of that part. The external opening may be very small, may be obscured by a fold of the skin, and may only be detected by squeezing pus out of it. The tract of the sinus can often be made out as a hard cord running in the wall of the bowel.

The site of the internal opening may sometimes be detected as a slight depression or papilla, or it may be demonstrated by the probe. In any case of doubt the finger may be dried and introduced into the bowel, and retained there while a little iodine is injected into the sinus. A brown stain upon the finger would prove that an internal opening existed, although it may not have been actually demonstrated.

The examination of a fistula should be very carefully conducted ; small pliable probes should be used, and in any case of difficulty a speculum should be employed. It must never be forgotten that the connection between the mucous and muscular coats of the bowel is comparatively lax, and that a large steel director, roughly used, will pass with great readiness through the submucous tissue, and will give rise to conceptions of burrowing sinuses which exist only as results of the surgeon's bungling.

To Percival Pott is due the credit of introducing the present method of operating. It was a common practice in his time to excise the entire sinus. It is still common to hear the uneducated classes speak of having a fistula "cut out." Pott demonstrated the possibility of curing fistula by simple incision.

Operation.—The patient is prepared in the same manner as is described in the previous chapter (page 677).

He is placed in lithotomy position, and is secured there by a Clover's crutch. It is assumed that an external opening exists. A Brodie's probe-pointed fistula director is introduced into the fistula, and is passed into the bowel through the internal opening. Not the very least force must be employed. The internal opening might have been already examined, and the passing of the probe may be carried out while a speculum keeps the inner opening in view. If the director does not easily pass, a flexible or especially bent probe may be introduced. If the probe is found to present under the thinned mucous membrane in a case in which no internal opening exists, the point of the director should be thrust through the mucous membrane at the thinnest spot. In every case, when possible, the probe should be passed while the left forefinger occupies the rectum and acts as a guide.

In a simple case in which the inner orifice is low down, the point of the director may be engaged upon the tip of the left forefinger (lying in the rectum), and may be cautiously brought outside the anus. Nothing then remains but to slit up the fistula with a sharp-pointed curved bistoury.

When the inner opening is high up, persistent attempts to bring the point of the director out of the anus may lead to undue laceration of the part.

In such a case, the sphincter having been very fully dilated, the interior of the bowel must be well exposed by means of a suitable speculum and well illuminated by means of a small electric lamp. The division is then made while the parts are in full view of the operator.

After the division of the fistula comes the most delicate part of the operation—the search for secondary fistulæ, for burrowing tracts, and for diverticula from the primary sinus.

For this examination again are needed a well-stretched sphincter, a speculum, rapid sponging, a good light, and suitable probes.

The finger should search for any tracts of indurated tissue, and the surgeon should note if the escape of a bead of pus follows pressure in any direction.

Any secondary sinuses must be treated as their condition indicates. Those which burrow beneath the mucous membrane should be slit up for their entire length. No object is gained by sparing the mucous membrane, and hesitating and incomplete incisions will always be regretted. Secondary sinuses, which pass away from the rectum, must be liberally slit up. When this involves too great a division of the soft parts, they may be freely opened into the original wound, may be dilated with dressing forceps and the finger, and well scraped with a sharp spoon or seared with the actual cautery and then well stuffed with gauze.

All the pulpy granulation tissue which is met with about fistulæ should in every case be scraped away. The surgeon should endeavour to leave as clean and fresh a wound as possible.

In the division of the fistula the anal margin is of necessity in every case divided, and in order that the section of the muscle fibres should be as direct as possible, the knife should always cut its way into the bowel at right angles to the anal margin.

If any piles exist, they should be removed at the time of the operation, and all ill-nourished flaps and tags of inflamed and undermined skin should be cut away.

In old-standing cases, when the edges of the fistula are very indurated and callous, Salmon's "back cut" may be carried out. After the usual division of the fistula, a linear cut is made through the dense tissue of the fistula, and through that portion of the sphincter muscle which is outside the tract of the fistula.

In certain *Blind External Fistulæ* the sinus extends as far as the levator ani, and then turns abruptly away from the rectum, instead of burrowing down between the sphincters. In such cases division of the sphincter would effect no good, but the sinus, on the other hand, should be very freely laid

open from the external orifice, should be seraped out, and then dressed from the bottom.

In *Blind Internal Fistulæ* the site of the threatened external opening may be indicated by a little redness of the skin, or by induration or fluctuation, or the tract of the sinus may be marked by an indurated cord.

In any such case a knife thrust through the skin at the point indicated would open the sinus, and allow of a director being introduced, and of the operation being concluded in the usual way.

Failing such indication, a speculum should be introduced, and the inner aperture sought for. When it is found, the end of a probe bent very much upon itself is introduced, and the point is made to project towards the skin. Upon this projecting point the first incision is made.

In cases of *Horseshoe Fistula*, in which an external opening on either side of the anus communicates with a single internal opening, usually at the back of the bowel, it is undesirable to cut through the sphincter on both sides. If this be done, much loss of power will result. It is better to divide the sphincter on one side, and to dilate the other side of the fistula to its utmost from the wound thus made, and to well scrape it. The cavity thus produced can then be dressed from the bottom. If, later, it should become necessary to cut through the anal margin upon the opposite side, much less loss of power results than is the case when the sphincter is divided in two places at one sitting.

When the *sinus extends far up along the bowel*, it should still be the practice to slit up the undermined tissues. When, however, the thickness of the structures to be divided renders it probable that much bleeding may ensue, the knife can be carried up as far as appears desirable, and the highest part of the sinus may then be treated by means of dilatation and scraping or by the actual cautery.

When *Multiple Fistulæ* exist, burrowing in various directions, it is well to adhere to the rule of dividing the sphincter in one place only. The sinuses are slit up in all directions, granulation tissue is scraped away, undermined skin is excised, fistulæ

which cannot be cut open are dilated, scraped, and dressed from the bottom. In these cases one or even more subsequent operations may be called for.

After-treatment.—It may almost be said that the after-treatment of the case is of more importance than the operation. When all bleeding has been checked, the parts should be well dried, and a folded piece of lint, or, better still, a strip of iodoform gauze, should then be lightly packed into the incision. A large pad of wool is applied over the part to maintain pressure, and to overcome any inclination to strain, and is fixed in place by a T-bandage. This outer dressing can be replaced later by a sanitary towel only. A morphia suppository may be employed. In forty-eight hours the first dressing should be removed, the part well washed, and re-dressed. The dressing consists of a folded piece of lint or of gauze firmly packed in the wound. It may be moistened with oil, or with iodoform or other ointment, or be merely dusted with iodoform. The whole of the gap or gaps made by the operation must be well and carefully stuffed from the bottom.

The part should be dressed night and morning, and after each action of the bowels. Scrupulous cleanliness must be insisted upon. A hip-bath may be taken daily after the action of the bowels.

The bowels should at first be kept confined, but should be opened by means of a dose of castor oil on the third or fourth day. It must be seen that they act regularly after this.

The discharge will be free for about the first ten days.

The dressing may need to be changed from time to time, and the lint may be soaked with sulphate of zinc lotion, with a nitrate of silver solution, with the compound tincture of benzoin, with weak iodine, or with such other drug as the surgeon employs in like cases.

The parts may be over-dressed, and the skin around be kept in a condition of irritable inflammation. Every care must be taken that the skin does not heal over prematurely, and a constant watch must be kept for burrowing sinuses and for undermining of the skin. "Pockets" for pus soon form, and good drainage should be maintained throughout.

The diet should be simple, but not meagre. Every means should be taken to improve the general health.

The operation will probably involve, in an ordinary case, confinement in bed for some fourteen days, followed by another week or so in the house. In a complex case, with many deep sinuses, the after-treatment may extend over many months. Rest is all-important, and the healing process is very distinctly retarded by too early movement. Change of air will often do more for an indolent sinus than will the most elaborate dressing. Some loss of power over the sphincter will be noticed for a little while. It is generally regained within three weeks. A permanent weakening of the anus may result, but it is very uncommon.

Other Methods of Operating.—Some surgeons employ specially-constructed scissors for dividing the fistula, but no particular advantage can be claimed for them.

The division of the tissues about a fistula by the thermo-cautery, the galvanic *écraseur*, or the wire *écraseur*, has nothing to recommend it.

The treatment of fistula by the elastic ligature was at one time extensively employed. It is attended by no hæmorrhage, and was recommended for cases of deeply-extending fistulæ. The ligature is made of a solid cylindrical rubber cord, one-tenth of an inch in diameter. One end of the loop is introduced along the sinus by means of a special director, while the other end hangs in the rectum. A pewter ring is then threaded over the two ends, and as the ligature is drawn tight the ring is made to clamp the two cords by compressing it with necrosis forceps. The ligature is allowed to cut its own way out. This it will effect, on an average, in six days. There is little to recommend the measure, which is attended by no little pain.

In individuals suffering from hæmophilia, I imagine that the risks of bleeding would be as great after the use of the ligature as of the knife.

It has not been shown that the after-treatment is shortened by this method.

CHAPTER III.

OPERATIVE TREATMENT OF PROLAPSE.

It is usual to divide prolapse of the rectum into two classes—the partial form, in which the mucous membrane is alone extruded, and in which the muscular coat remains unchanged in position.

The complete form, in which all the coats of the rectum, including the peritoneal covering, are extruded, and are involved in the prolapse. The partial prolapse is usually of slight extent, and may measure but an inch or two in length. In the complete variety the protrusion is more extensive, and may measure as much as six inches, or even more.

The methods of treating prolapse by operation are numerous. Many of these have fallen entirely into disuse, while some appear to have commended themselves to few other than the actual inventors.

It is needless to describe the treatment by the injection of various fluids into the ischio-rectal fossa, nor to do more than allude to the treatment by excising elliptical folds of skin and mucous membrane from the margin of the anus. Removal of the mass by the galvanic or cold wire *écraseur* has not proved to be an encouraging procedure; and the same may be said of the “radical cure” by means of elastic ligatures, aided by the liberal application of chloride of zinc.

Three operations will be described—the operation by caustics or the cautery, by excision, and by fixation to the abdominal wall.

1. Treatment by Caustics or the Cautery—The bowels having been evacuated according to the method advised in preparing a patient for operation for hæmorrhoids (page 677),

the subject is placed in the lithotomy position, and the thighs are secured by a Clover's crutch.

With a little manipulation the prolapse can usually be made to protrude, or it may be drawn down with forceps. It is then well dried with cotton-wool, and is ready for the application of the caustic or cautery.

The usual caustic employed is strong nitric acid. This is painted over the whole of the exposed surface, care being taken that none of the acid touches the verge of the anus or the skin. The part is then well oiled and returned, and the rectum is lightly stuffed with gauze soaked in oil. Outside the anus a supporting pad of wool is fixed firmly in position by a T-bandage.

If the actual cautery be employed, the iron, heated to a dull-red heat, is applied to the whole length of the prolapse, in the form of a series of lines in the long axis of the bowel. Four of such linear burns at equal distances from one another will suffice. The width of each line will be about one-fourth of an inch. The burn should be sufficiently deep to sear, but not actually destroy, the mucous membrane.

The operation should be performed quickly, and the prolapse at once returned, before any swelling takes place.

To carry out this measure, it is essential that the prolapse should be extruded.

A morphia suppository is introduced into the bowel, and after it a slight plug of well-oiled gauze. The anal region is then well supported by a substantial pad of wool under a firm T-bandage.

The *after-treatment* involves lying in bed for two to three weeks. The plug of gauze is removed from the rectum in twenty-four hours. Opium will be needed to overcome the disposition to strain which is often complained of. Flatus is got rid of by passing a rectal tube two or three times a day as required. The bowels should be opened with castor oil on the fourth day. An oil enema may assist the process. The motion should be passed while the patient lies upon the side, as described in the section on the excision of piles (page 687). There must be no straining, and no bed-pan must be employed. After the fourth day the bowels should be made to act daily.

2. Treatment by Excision.—This operation may be illustrated by two actual cases—one of partial and the other of complete prolapse, both treated by excision.

I have given an account of this operation, with three illustrative cases, in a paper published in the *Lancet* for March 1, 1890. Cases of excision of the prolapsed bowel have been reported by Mr. S. Partridge, Mr. Rayc, and others. (See *Indian Annals of Medical Science*, No. xxvii., page 237; and *Lancet*, July 10, 1886.)

Case of Partial Prolapse.—Man aged thirty-seven; length of prolapse five inches. The patient was prepared as for the operation for piles, was placed in lithotomy position, and secured by Clover's crutch. The buttocks were well raised, partly for the purpose of bringing the region in more convenient position for operation, and partly that the coils of small intestine might be to some extent withdrawn from the pelvic floor in the event of there being any protrusion of the peritoneum. After a thorough dilatation of the sphincter, the first step of the operation consisted in demonstrating the full extent of the prolapse. The mucous membrane within the lumen of the prolapse was seized, at some height above the aperture in the bowel, with tongue forceps, and pulled down. Three pairs of such forceps were employed, and were applied at different points on the rectal wall; and when it was evident that the whole of the relaxed mucous membrane was entirely drawn down, the forceps were allowed to remain attached. They served to indicate the real apex of the protrusion, and to allow a hold to be taken of the part, while their weight prevented any great recession of the everted mucous membrane.

I now made a circular cut around the base of the prolapse, at the exact spot where the skin joined the mucous membrane. The incision involved the mucous membrane only. This mucous membrane I next proceeded to dissect off, turning the whole of it down like a cuff.

It was dissected up with scissors and forceps only. When the separation was complete, the prolapse had an hour-glass shape, the waist of the hour-glass corresponding to the site of the apex of the protrusion. Nothing but a raw surface was

visible, and the prolapse was, of course, doubled in length. The bleeding was quite insignificant. The object of this dissection was to clearly demonstrate the nature of the tissues forming the prolapse, which were about to be excised. Both sphincters could be defined. I now introduced my left forefinger into the lumen of the prolapse, and ascertained that the protrusion was composed of mucous membrane only. The layer of mucous membrane—the inner layer—I next divided at the level of the anus with scissors. As each inch or so was divided, the cut margin was seized with pressure forceps. This allowed of the immediate arrest of all bleeding, and also prevented the mucous membrane from being withdrawn into the rectum. The prolapse was in this way completely excised, and some six or eight pressure forceps were left attached to the cut mucous membrane of the rectum. The forceps were removed, bleeding points were ligatured, and the mucous membrane was then attached to the skin at the margin of the anus with sutures of silkworm gut. Eight vessels were ligatured, and fifteen sutures were applied.

The part was dressed with wool dusted with iodoform. The bowels were opened on the fifth day; the sutures were removed on the tenth. At the end of four weeks the parts were sound, and the function of the anus was entirely restored.

Case of Complete Prolapse.—Man aged thirty-six; prolapse measured five inches in length. Its circumference at the base was no less than ten and a half inches. The operation was commenced in the manner already described. The mucous membrane forming the outer wall of the prolapse was separated all round, as in the above case, the knife traversing the skin close to its line of junction with the mucous membrane. The protrusion, quite bared of mucous membrane, was now exposed.

It felt hard and firm, except at its anterior part, close to the anus. Here there was evidence of a protrusion of peritoneum. The wall of the cone was at this point flaccid, and compared very markedly with the firm wall presented by the rest of the prolapse. The buttocks had been well raised, to hinder the protrusion of any coils of small intestine, and no evidence of such a hernia existed. I then cut across the

prolapse at the level of the anus—*i.e.* at the very base of the cone. I divided the anterior wall first, and opened the peritoneal cavity; the opening was at once plugged with a sponge. The rest of the prolapse was then severed rapidly with scissors in the manner already described. The peritoneal wound was closed by seven points of the finest catgut. The divided end of the bowel was then attached to the margin of the anus, all hæmorrhage having been arrested. The sutures involved the skin, the whole thickness of the wall of the rectum, and as much as possible of the subcutaneous structures about the anus. Silkworm gut was employed. The bowels were opened on the seventh day; no sutures were removed until the thirteenth day. The patient got up on the nineteenth day. The wound healed soundly, without a drop of pus. Control over the anus was slowly regained, and the patient was discharged “cured” at the end of six weeks.

3. Ventrifixation (Colopexy).—In view of the success following suture of the uterine fundus to the anterior abdominal wall in some cases of prolapse of the uterus, it was natural that a similar procedure should be tried in severe cases of rectal prolapse. In the worst of these all the coats of the rectum, including the peritoneum, descend below the anus, and it may be said that the whole of the rectum and lower part of the sigmoid are at fault. Hence if the latter can be securely fixed by sutures to the abdominal wall on the left side just above Poupart's ligament, the tendency to prolapse will be at least much diminished. It appears that upwards of thirty such cases have been published, and the results are sufficiently encouraging to justify further trial. Mr. Charles Morton (*Brit. Med. Journ.*, April 13, 1901) states that of thirteen cases followed up more than six months after the operation, nine were cured; in the other four there was more or less recurrence. In some of the earlier operations (dating from 1889, when Verneuil and Jaennel reported cases) faulty methods were employed. Thus the appendices epiploicæ were relied on for fixation, with a result that might have been expected; or an artificial anus was made in the groin—a proceeding that cannot be justified in the treatment of prolapse.

The safest part to suture is the mesorectum or mesosigmoid, as, if the wall of the gut or the longitudinal band is traversed, there is risk of either a fistula or a ventral hernia. The procedure is as follows:—

The patient's intestine has been well cleared by aperient and enema. By raising the pelvis during the operation the small intestines are prevented from getting in the way. An incision of two to three inches is made through the abdominal wall on the left side an inch above and roughly parallel to Poupart's ligament, corresponding to that made on the right side for excision of the vermiform appendix. The internal oblique and transversalis are divided between their fibres rather than across them, and after opening the peritoneum the sigmoid is made out and its course followed down until the upper part of the rectum is reached. The effect of traction on the mesentery of this part with regard to the prolapse is then ascertained, and a piece selected for suture which can be fixed to the parietal wound without involving too great tension. Two, three, or more sutures are now passed through one edge of the cut parietal peritoneum and transversalis fascia, then through the mesosigmoid, where it is passing into the mesorectum, and finally through the opposite edge of the wound. These buried sutures may be of silk or kangaroo tendon, and when tied they both fix the bowel and close the peritoneal wound. A few tendon or silkworm-gut sutures close the incision through the muscles, fasciæ, and skin. No drainage is required.

In the *after-treatment* it is necessary to avoid prolonged constipation. The bowels should be gently moved at the end of three days.

Comment.—Of the value of the measures above described considerable differences of opinion have been expressed.

Speaking from my own experience of these operations, I would venture the opinion that the treatment by strong nitric acid is barbarous and uncouth, and a survival of the surgery of past ages. It is very painful. It has been followed by sloughing and acute inflammation of the rectum, and has led to severe, and even fatal, hæmorrhage, and also to stricture.

The treatment by means of the actual cautery appears to be fairly well suited to mild forms of the trouble which have resisted all modes of treatment short of those by operation. The measure is painful, a severe degree of inflammation is excited, some sloughing is inevitable, and the special dangers of a burn are introduced. The depth of the burn is not easily regulated, and stricture may form on the one hand or a relapse occur on the other.

For severe cases, I venture to think that the treatment by excision is distinctly the best.

A clean incision is made, the operation area is reduced to a minimum, no damaged bowel is left in the pelvis, hæmorrhage may be rendered practically impossible, and the after-treatment is of comparatively short duration.

Inasmuch as the parts are cleanly excised, and as the whole of the operation is conducted without the anus, the risk of subsequent stricture must be small. This risk is, of course, avoided by ventrifixation, although it is yet too early to pronounce on the permanent value of this operation. So far as experience has as yet shown, the measure has been attended with fair results at a small risk. There is, however, a distinct objection to the rendering of a coil of bowel adherent, even when that coil is so near the anus as is the case in the present instance.

CHAPTER IV.

EXCISION OF THE RECTUM.

EXCISION of the rectum, or proctectomy, is carried out in certain cases of malignant disease involving the lower part of the rectum. The operation has also been employed in examples of extensive and intractable non-malignant stricture of the rectum, especially when associated with widespread ulceration. As, however, such applications of the operation are exceedingly rare, the present chapter will be considered to deal only with excisions in cases of cancer.

The term excision of the rectum is a little misleading, inasmuch as the excision seldom, if ever, involves the entire rectum, as it is anatomically defined. It is usually restricted to the removal of a comparatively small part of the bowel.

The operation is the subject of very considerable differences of opinion, these differences being for the most part concerned with the advantages to the patient to which the operation may lay claim.

The value of the procedure is discussed in subsequent sections, and it is only necessary to say here that excision of the rectum is not to be lightly undertaken, and that the measure has been distinctly disappointing in its results. In not a few instances the patient has gained little from the operation but increased discomfort, and his life has been extended for no longer a time than would have attended a simple colotomy.

The operation appears to have been originally performed by Faget in 1763. It was, however, little noticed by surgeons until the procedure was revived by Lisfranc in 1830. The method adopted was that known as the perineal operation.

A new aspect was given to the procedure by Kraske, who

introduced sacral proctectomy and carried out his first operation successfully in 1885 (*Archiv für klin. Chir.*, 1886, Bd. xxxiii., page 563). Conspicuously associated with the development of the operation must be mentioned the names of Czerny, Heinecke, Kocher, Hochenegg, Heuston, and Ball.

Indications for the Operation.—The cases suitable for this operation are those of cancer of the rectum in which the growth is low down, is in an early stage, is small, and is quite limited to the rectum. The operation is not to be carried out when the malignant growth has extended beyond the rectal wall and has invaded the surrounding connective tissue, or has made its way to the prostate, bladder, uterus, or vagina. Carcinoma is met with in all parts of the rectum, but is more frequently located in the lower two or three inches of the bowel.

For the purposes of this operation the following classification by Quénu (*Presse Médicale*, November, 1895) is of value.

1. Cancers of the anus, growths which have involved the bowel below the attachments of the levatores ani.

2. Cancers which occupy the suprasphincteric zone of the rectum, but are infraperitoneal.

3. Cancers placed high up in the bowel, their lower limit being above the level of the peritoneal *cul de sac*.

4. Cancers which extensively involve the rectum, reaching from the anus to a considerable distance upwards.

Preparation of the Patient.—A few days' rest in bed previous to the operation is of considerable service. The diet should be of the simplest kind, and of a type which will leave the least possible residue in the bowel. If the patient has very defective teeth, all food requiring careful mastication should be avoided. Such patients therefore will be denied all meat. The bowel should be well cleared out by aperients, and repeated enemata given by means of a carefully graduated douche.

It may be necessary to pass a small rubber tube through the stricture in order the more effectually to wash out the bowel.

The use of certain reputed "intestinal antiseptics" is advised by many writers, such as resorcin, salol, β naphthol, and salicylates of bismuth or quinine.

A preliminary temporary colotomy is proposed by some surgeons, but has little to recommend it. Such a measure is an indifferent preparation for the major operation; it involves a waste of time, it may prevent the complete pulling down of the gut during the excision, and cannot be said to be of any material help to the surgeon. A preliminary colotomy may be needed in cases in which obstruction exists and in which the bowel cannot be emptied by either aperients or enemata. In such examples, however, it is more than probable that the disease is so advanced as to render excision unjustifiable. A permanent colotomy may be carried out with advantage in certain cases. (*See Colotomy chapter, page 338*).

Some writers recommend a curetting of the growth as a preliminary to the excision. There is, however, nothing to commend this measure, which is not free from risk, and which may involve troublesome bleeding.

Instruments Required.—Clover's crutch; curved sharp-pointed bistoury; straight probe-pointed bistoury; scalpels; straight blunt-pointed scissors; scissors curved on the flat; two pairs of volsella forceps; dissecting forceps; a liberal supply of pressure forceps; artery forceps; sponges in holders; rectal speculum; syringe; Paquelin's cautery; ligatures; curved needles. *For the sacral operation*—in addition, suitable metal retractors; periosteal elevator or rugine; small saw; bone-cutting and bone-holding forceps; chisel and mallet; bone gouge.

The following operations will be described:—

1. The operation for anal cancer.
2. Excision of the rectum by the perineal route.
3. Excision of the rectum by the sacral route (Kraske's operation).
4. Excision of the rectum by the perineo-abdominal method.

1. THE OPERATION FOR ANAL CANCER.

The patient is placed in lithotomy position. The rectum is washed out and the skin around the anus cleansed and shaved.

With a scalpel an incision is made around the anus and in the skin at a distance which will be well clear of the disease. This incision is deepened all round, and the anal tissues gradually separated. This separation is effected by blunt-pointed scissors aided by the finger. The attachments of the gut are cleared on all sides for some little way above the line of intended division. The division is made with scissors through healthy tissue and in a line at right angles to the long axis of the bowel. Bleeding vessels are secured by pressure forceps. By means of a curved needle in a handle the divided mucous membrane is secured to the divided skin by means of a series of deeply-placed dry catgut sutures. These sutures are so placed with reference to the severed vessels that the same are occluded when the knots are drawn tight. Some surface sutures of finer gut will be needed to make complete the line of union.

The inguinal glands should be examined and removed if found to be enlarged.

The *after-treatment* is identical with that observed after Whitehead's operation for piles (page 684).

2. EXCISION OF THE RECTUM BY THE PERINEAL ROUTE.

The patient is prepared in the manner described on page 703, is anæsthetised, and is placed in the lithotomy position, the lower limbs being secured by means of Clover's crutch.

A good light is required, and at least one thoroughly efficient assistant. The left forefinger is passed into the rectum, and the position of the coccyx is defined; a curved sharp-pointed bistoury is now introduced into the rectum by the side of the left finger, and is made to cut directly backwards and precisely in the median line. In this way all the soft parts between the rectum and the coccyx are cleanly and completely divided. The lateral incisions are now made. The position of each will depend upon the distance between the growth and the margin of the anus. Whenever possible, these lateral incisions should be made through the mucous membrane. When the growth actually reaches the anus, they must of necessity be made

through the skin. If any mucous membrane can be saved with safety at the anal margin it is well, as the risk of subsequent contraction is much lessened.

Each incision is commenced behind, at the posterior wound already made, and is carried boldly into the ischio-rectal fossa.

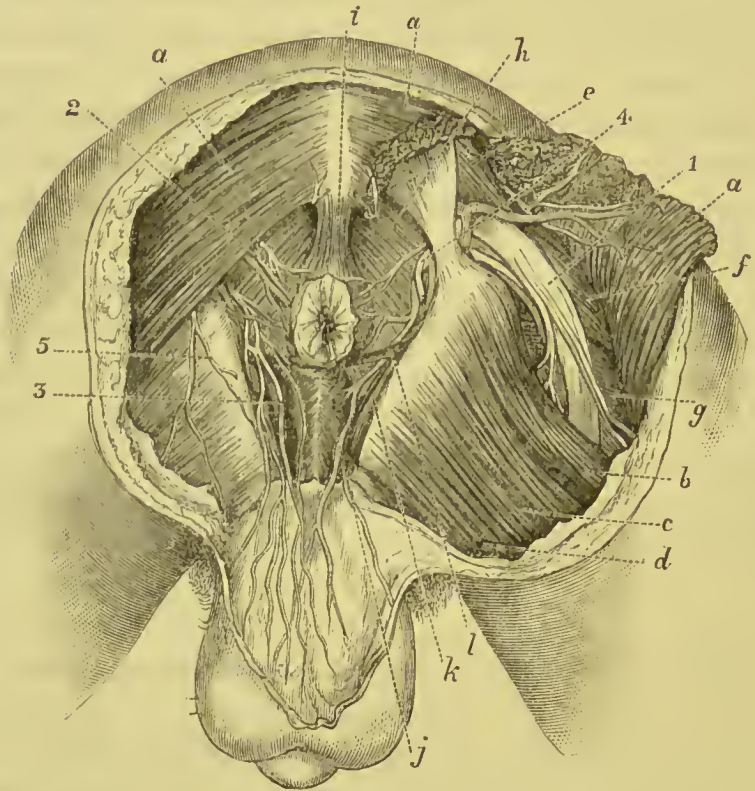


FIG. 453.—PERINEUM OF THE MALE, SHOWING THE SPHINCTER AND LEVATOR ANI, ETC., WITH REFERENCE TO EXCISION OF THE RECTUM. (After Rüdinger.)

a, Gluteus maximus; *b*, Semi-tendinosus and biceps; *c*, Adductor magnus; *d*, Gracilis; *e*, Piriformis; *f*, Obturator internus; *g*, Quadratus femoris; *h*, Levator ani; *i*, External sphincter; *j*, Accelerator urinae; *k*, Erector penis; *l*, Transversus perinei. 1, Great sciatic nerve; 2, External hæmorrhoidal vessels and nerve; 3, Superficial perineal vessels and nerves; 4, Pudic nerve (cut) and pudic artery; 5, Pudendal branch of small sciatic nerve.

The corresponding buttock is steadied and held aside as the cut is being made. All bleeding points are at once seized with pressure forceps.

The finger, thrust into the incision on each side, will readily separate the rectum, except at the insertion of the levator ani. The fibres of that muscle must be divided with scissors. The two lateral incisions are crescentic, and are so carried round the bowel as to meet in front. As each one is finished,

and as the separation on each side and behind is completed, the deep wound outside the rectum thus left by the scalpel and the finger is plugged with a sponge.

The lateral and posterior parts of the rectum are thus freed.

Dr. Edward H. Taylor (*Annals of Surgery*, April, 1897), advises the following method of carrying out this, the first step of the operation: "Begin by a median posterior incision behind the anal margin and extend it backwards in the middle line over the coccyx. Then, starting from the tip of this, follow the median raphe forwards, splitting the posterior part of the external sphincter and separating the levatores ani. On introducing the index finger into the wound, the rectum is easily cleared on its posterior and lateral aspects. Strong blunt-pointed scissors are now taken, one blade is placed in the wound just behind the anus and in the interval between the rectum and the levator ani, the other blade rests upon the skin. The bridge of tissue between the blades is now cut, and a similar section made upon the opposite side. These lateral incisions are extended towards the middle line in front, cutting the levatores all round from the rectum."

The next step is the difficult one of separating the bowel from its anterior connections. In the case of a male subject this is much facilitated by having a full-sized catheter passed into the urethra, and held in the position of the staff in lithotomy. In the female, the finger introduced from time to time into the vagina will afford valuable guidance. The portion of the bowel already detached is held by an assistant, who draws it downwards. The surgeon proceeds to separate the gut from its anterior connections by means of blunt-pointed scissors, aided by the left forefinger. A digital examination *per rectum* and *per vaginam* from time to time will assist in estimating the position of the line of separation.

When the rectum has been freed all round well above the upper limits of the disease, the gut is cut across transversely by scissors. The section should be made if possible at least one inch above the growth. The division should be made cautiously and in sections, and all bleeding vessels are secured at once with pressure forceps. These forceps serve also to

maintain a hold upon the divided intestinal wall. The wound cavity is now syringed out and dried. The sponges in the ischio-rectal fossa are removed, and the vessels held by the

pressure forceps are secured as required; some will have been already closed by pressure, others can be dealt with by torsion, and the remainder by ligature.

The hæmorrhage varies a great deal; but as the chief bleeding vessels are situated in the wall of the bowel, they are readily secured. Such venous oozing as exists will usually yield to pressure, and in any case will cease, more or less completely, when the body is put out of the lithotomy position.

The use of the cautery should be avoided whenever possible. It obscures the anatomical details of the parts, involves sloughing, and necessitates much after-contraction of the wound.

Much difference of opinion exists as to the manner in which the operation should be completed. Some surgeons advise that the mucous membrane should be drawn down, and attached to the skin at the anal margin by means of a close row of sutures. If this be done

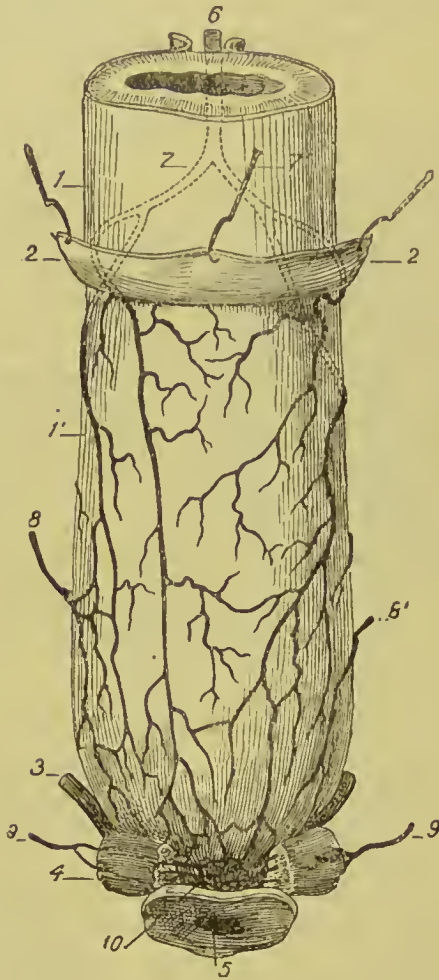


Fig. 454.—VASCULAR SUPPLY OF RECTUM.
(After Testut.)

- 1, Peritoneal coat, reflected at 2, from anterior surface of rectum; 3, Levator ani; 4, Sphincter ani; 5, Anal orifice; 6, Superior Hæmorrhoidal artery (the termination of the inferior mesenteric); 7, Division of the superior hæmorrhoidal artery into two main branches about five inches above the anus: these are seen further dividing so as to form four descending trunks in front of and behind the lower part of the rectum; 8 and 8', Anastomosing branches from the middle hæmorrhoidal; 9, Inferior hæmorrhoidal branches from internal pudic; 10, Terminal anastomotic plexus, region of internal piles; 1', Wall of rectum.

the sutures must take hold not only of the skin and the bowel wall, but also of the surrounding pelvic tissues. Drainage-tubes will also need to be inserted here and there between the sutures. Other surgeons condemn this measure, and state that the stitches are sure to give way; that so long as they hold they prevent a free discharge from the wound, and permit spaces to form outside the bowel.

This objection is not well founded if the wound be carefully drained and well attended to.

Those who advise the suturing of the divided parts claim that the wound surface is thus greatly diminished, that the duration of the after-treatment is shortened, and that the tendency to stricture is obviated. That the slow closure of a long tract in the rectum by the process of granulation may lead to stricture cannot be denied.

Ball points out that a great deal depends upon the manner in which the sutures are introduced. If the skin and the margin of the gut be merely sutured together, then pouches will certainly form outside the bowel, and the hold of the sutures will be slight. If, on the other hand, the threads be passed deeply through the surrounding pelvic structures as well as through the skin and mucous membrane, then the stitches will be scarcely able to cut their way out, and no pockets for pus can be left outside the bowel.

Mr. Bidwell (*Brit. Med. Journ.*, October 21, 1899) advises that two transverse incisions some two inches long should be made on each side of the perineal incision. The flaps of skin so formed are then dissected up and attached to the cut end of the rectum by silkworm-gut sutures. This can usually be carried out without undue tension.

The operation as above described applies to the removal of the whole circumference of the bowel. There is nothing to be said in favour of excision operations in which a part only of the circumference is removed.

It is needless to say that no more should be removed than is consistent with a free, complete, and proper excision of the growth, and that the preservation of any part of the anal margin is always desirable.

If only a little of the anal margin can be preserved, the amount of the after-contraction is considerably lessened.

The perineal method is not well suited for malignant growths situated *above* the sphincteric region. The procedure does not provide sufficient room for dealing with cancers so placed. There is a difficulty in precisely identifying the limits of the diseased tissue, and in bringing the bowel, after division, sufficiently well down to effect an easy union with the skin margin. Moreover, the bleeding is often free, and, owing to the depths of the bleeding surface, is not easy to control.

In instances, therefore, in which the growth is distinctly above the sphincteric area, the next measure is to be advised.

3. EXCISION OF THE RECTUM BY THE SACRAL ROUTE.

The bowel may be reached in two ways :—

- A. By definite sacral resection (Kraske's operation).
- B. By temporary sacral resection or by a parasacral incision.

The full description of the operation will be given in connection with the first-named of these methods, which may be described as Kraske's operation as now usually practised.

A. Kraske's Operation—the Method by Definite Sacral Resection.—The purpose of this operation is to obtain a free access to the diseased bowel from the sacral side, to remove it liberally, and to preserve at the same time the sphincteric function of the rectum.

Position of the Patient.—The patient is prepared as described on page 703. The skin of the operation area will have been shaved and well cleansed. The patient lies upon the right side with the knees drawn up and with the buttocks projecting over the foot of the table. The buttocks are well raised upon a large, hard, solid cushion or sand-bag. The surgeon sits facing the foot of the table. This position of the patient is retained until the rectum is well exposed and the posterior part is freed. During the remainder of the operation the patient is placed in the lithotomy position with the pelvis well raised upon a firm support.

Some surgeons keep the patient in the lithotomy position throughout the whole operation from the commencement to the end.

Others place the patient from the commencement upon the face with the lower limbs—suitably supported and secured—hanging over the foot of the table, and the pelvis, therefore, at the very edge of the table. This position has great disadvantages during the later stages of the operation, and considerably embarrasses the work of the anæsthetist.

The operation is carried out in three stages :

- (1) The exposure and separation of the bowel.
- (2) The removal of the bowel.
- (3) The treatment of the divided ends of the bowel.

(1) **Exposure and Separation of the Bowel.**—When the patient is in position the bowel may be finally irrigated with 1 in 5,000 perchloride of mercury solution, and dried with iodoform gauze, a light plug of which may be allowed to remain in the gut.

An incision is made in the median line from the posterior edge of the anus to the centre of the sacrum. The knife passes to the bone at once. The soft parts on the left side of the wound are detached *en masse*, and drawn outwards. They include part of the gluteus maximus. The left side of the sacrum is thus bared and brought well into view. The sacro-sciatic ligaments attached to this left border are divided, as are also the ligamentous attachments on both sides of the coccyx. The coccyx is now freed on all sides from its muscular attachments, and is left bare. The soft parts in the hollow of the lower part of the sacrum are detached with a rugine. They include the sacra media vessels and the venous plexus which lies in front of the sacrum. The coccyx is now removed entire:

Should sufficient space to reach the diseased segment of the rectum not be provided, a portion of the left side of the sacrum is removed. The soft parts are more fully retracted on the left side, and the sacrum is divided along a curved line, which commences at the left margin of the bone at the level of the third posterior foramen, runs downwards and inwards

to the right of the fourth foramen, and ends at the lower border of the fifth sacral vertebra (Fig. 455). This division of the bone is carried out by means of a gouge or a chisel and mallet, according to the surgeon's familiarity with those instruments in dividing bone.

It will be observed that the anterior division of the third sacral nerve is not severed, and that the sacral canal is not

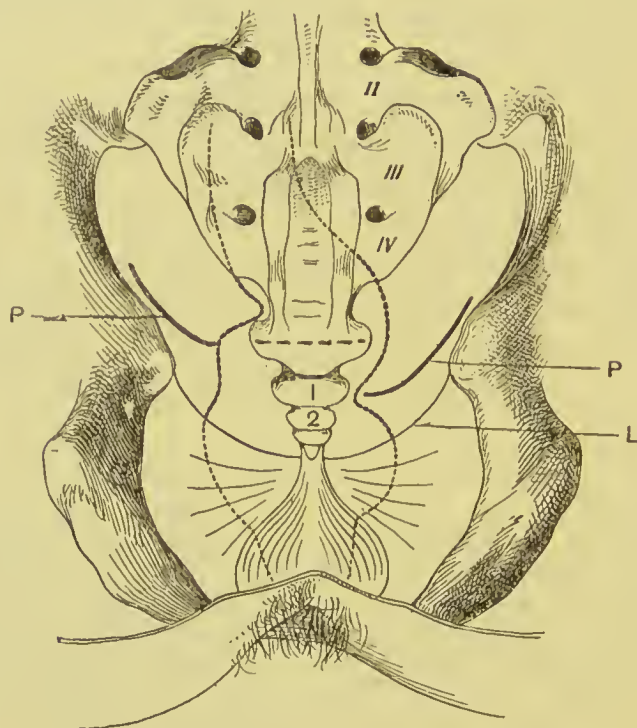


Fig. 455.—DIAGRAM OF RECTUM FROM BEHIND (after Hartmann).

P P, Level of reflexion of peritoneum; L, Upper edge of levator ani. The dotted line across the last piece of the sacrum indicates the best level for excision of the bone.

opened. The bleeding (which may be free) is largely venous, and yields to pressure.

The opening obtained by the removal of the bone gives access to some six or eight inches of the bowel, and allows of a free removal of the diseased segment.

The operator now divides the tissues over the rectum in the posterior median line, such section including the levatores ani. He clears the bowel posteriorly. When that is accomplished, the patient is placed in lithotomy position with the pelvis well raised, and the attachments of the rectum are

approached anteriorly. The separation of the bowel is effected by the fingers, aided by blunt-pointed scissors and occasional dissection, and great care must be taken of the urethra and prostate in the male, and of the vagina and uterus in the female.

In the male subject a sound is introduced into the urethra as a guide, and in the female a frequent digital examination through the vagina will notify an encroachment on that passage.

The separation of the rectum must be carried out with great care, and on no account must the bowel be forcibly dragged upon. The complete separation of the rectum anteriorly cannot be effected until the bowel has been divided below, and until, indeed, its removal is in progress.

(2) **Removal of the Bowel.**—Whenever possible the anus should be left intact. If the growth does not reach to within one inch of the external sphincter, then that muscle and the anus may be left undisturbed.

The rectum is divided first of all transversely below the growth, and the section should be, if possible, one inch below the margin of the cancer. The best case, therefore, for the operation—other things being equal—is one in which the lower edge of the growth is two inches from the anus.

Before the bowel is divided, it should be clamped or ligatured below the growth in order to prevent any escape of matter from the interior.

The complete separation of the bowel anteriorly is now proceeded with.

In due course the peritoneum will be reached as it is reflected from the anterior wall of the gut. If the growth be low down the bowel may be cleared at a sufficient height by merely pushing up the serous membrane without opening it. If this is, however, not possible, the peritoneum must be freely divided. The gut is now retained in place by the mesorectum. This structure, together with the presacral connective tissue, is separated from the hollow of the sacrum, and the bowel thus freed is drawn down into the wound.

The rectum is now clamped at a point from one inch to one

and a half inches above the growth, and is divided close to the lower edge of the clamp, care being taken by means of a liberal plugging of gauze all round the seat of section that none of the contents of the gut escape into the wound cavity.

As the final attachments of the bowel are severed, any bleeding vessels are seized with pressure forceps. Great care must be taken to preserve intact the vessels which pass *viâ*

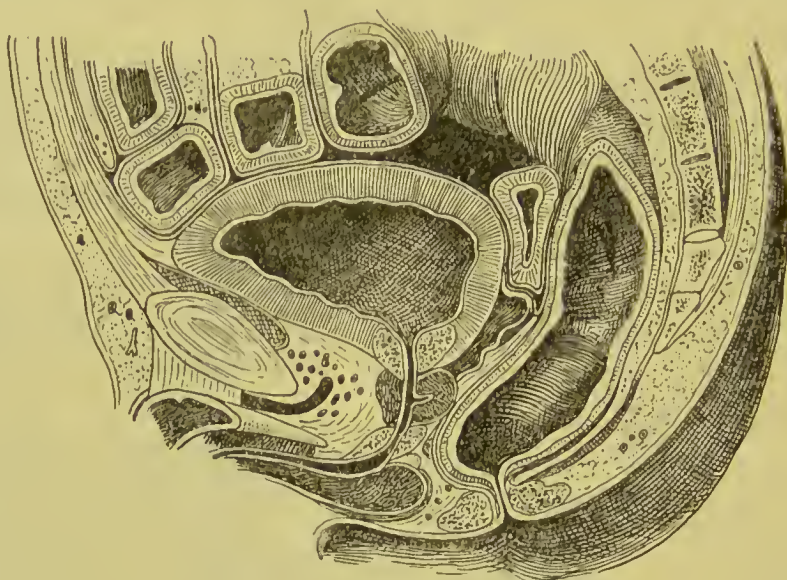


Fig. 456.—MEDIAN SECTION OF RECTUM AND BLADDER, ETC., IN THE MALE.
(From Testut.)

The relations of the peritoneum and sacrum and coccyx respectively to the rectum are shown; it will be noticed how much of the rectum can be reached after excision of the coccyx.

the mesorectum to such part of the bowel as is left behind. If heed be not paid to this the rectal stump may slough. The stump of the rectum is well dried and washed with a 1 in 2,000 solution of perchloride of mercury. The opening into the peritoneal cavity—if such has been made—should be closed by means of a continuous silk suture, which can be rapidly introduced. Kraske advises that this opening should be merely plugged with iodoform gauze, but the protection of a line of suture is very much to be preferred, and should always be attempted.

(3) **Treatment of the Divided Ends of the Bowel.**—Whenever it is possible, immediate direct suture of the divided ends

of the bowel should be carried out. The gut above the growth thus comes to be attached to the sphincter and the anal part of the rectum. When the sphincter and anus have been left untouched, the anterior and lateral portions of the rectum are united by two rows of sutures, one involving the whole thickness of the gut and the other the mucous membrane only. The posterior portion—which is necessarily dealt with last—is closed by deeply-placed sutures which do not reach to the mucous membrane. When the sphincter and anus have been removed, the attempt should be made to unite the severed bowel to the skin.

In such case the free end of the bowel is fixed to the skin at the posterior angle of the wound by numerous deep and superficial sutures. In this way the “sacral anus” as recommended by Hochenegg (*Brit. Med. Journ.*, vol. i., 1900, page 1031) is made.

When the bowel is about to be attached to the skin, Gersuny (*Zentral. für Chir.*, 1893, No. 6) recommends that the upper end of the gut, if long enough, should be twisted upon itself before it is fixed to the skin by sutures. It is seized by forceps, and is rotated around its own long axis, until resistance is offered to the attempt to introduce the finger into the bowel. The gut is fixed to the skin in this twisted condition, and the escape of its contents is thus much hindered.

Willems (*Zentral. für Chir.*, 1893, p. 401) and Witzel (*Zentral. für Chir.*, 1894, No. 40) have treated the lower end of the rectum by drawing it through an aperture made in the lowest part of the gluteus maximus before uniting the divided surface to the skin. It is assumed that the fibres of the gluteus muscle will have some sphincteric action.

Other methods of dealing with the severed bowel are described. Thus Paul (*Lancet*, vol. ii., 1897, p. 78) does not attempt approximation of the divided ends if more than three inches of the bowel have been removed. He introduces a large glass drainage-tube into the wound. The upper end of this tube enters the bowel, and is secured to it by means of a ligature. The divided end of the gut is sutured to the uppermost corner of the wound. The tube comes away about the fourth day. For the union of the severed gut, Murphy's button, and also the

bone bobbin, have been used with success. It is only in exceptional cases, however, that they can be employed.

Other surgeons perform a preliminary inguinal colotomy, and entirely close the divided end of the bowel. This method has very considerable and obvious advantages, and will be alluded to subsequently (page 722).

After-treatment.—It will be obvious that the main feature in the after-treatment consists in the most careful attention to the wound. It should be very frequently irrigated with dilute perchloride of mercury solutions, and should be kept as dry as possible. A constant outlook should be maintained for retained secretions or retained pus. The wound (within reasonable limits) cannot be dressed too often. If the bowels have been very well evacuated before the operation, they may be kept confined for the first six days after the operation. Some surgeons would extend this period to eight days. It is impossible, however, to follow any rule in these cases, especially in those in which there has been considerable irritation of the bowel above the stenosed part. In any case the fresh irrigation of the wound must follow every action of the bowels. A catheter will probably need to be employed.

The position of the patient will need to be frequently changed in order to secure efficient drainage.

The patient will need to be kept in bed until the process of granulation is well advanced. As soon as he is able to move, a daily hip-bath is an advantage.

The anal passage must be frequently examined for stricture, and any threatened narrowing met by the passage of bougies or by other measures.

Numerous pads, plugs, trusses, and belts have been devised to meet the incontinence of feces which is common after these operations.

B. The Operation by Temporary Sacral Resection, or by a Parasacral Incision.—In the operations of the first series the bone is divided, and a long flap is turned back which is replaced as soon as the excision of the rectum has been completed. The intention is to provide a wound the healing of which will be more ready, and at the same time to disturb as

little as possible the support of the pelvic viscera. There are many methods.

Heinecke (*Münchener med. Wochens.*, 1888, No. 37) divided the sacrum transversely below the fourth foramina, and made a second section of the bone vertically in the median line from the tip of the coccyx to the centre of the horizontal incision. The cuts in the bone, therefore, formed a T. The two triangular osteo-integumental flaps thus made were forcibly turned outwards and the rectum exposed. After the excision the flaps are replaced.

Heinecke's operation was the first of its kind, and has been the subject of numerous somewhat unimportant modifications. The modifications are chiefly concerned with the placing of the bone incisions.

The best, however, of the osteo-plastic methods is that known as the operation of Reyn (*Beilage zum Zentral. für Chir.*, 1890, No. 25) and Rydygier ("Manual of the Universal Medical Sciences," 1894, vol. iii.).

An incision is commenced at the left posterior superior iliac spine, and continues along the left side of the sacrum, about half an inch from the margin of the bone. It reaches the coccyx, and is prolonged in the median line to the anus. At the upper end of the wound the margin of the sacrum is exposed, and the sacro-sciatic ligaments are divided. The anterior surface of the sacrum is cleared of the tissues which cover it, and a transverse incision is carried across the bone just below the third sacral foramina. This incision is made with a chisel. The triangular flap thus marked out is turned over to the right side, and is replaced after the excision of the bowel has been completed.

In general terms it may be said that the formation of osteo-integumental flaps is good in theory. It spares the absolute removal of healthy parts, it leaves but little disturbed the actual long and ligamentous floor of the pelvis, and affords good support to the viscera. If, however, the wound become infected, necrosis of the replaced bone may follow. The wound is apt to be so narrowed and to hamper an efficient drainage, and, above all, the measure is not possible when a sacral anus has to be made.

In the parasacral method the bowel is reached by means of a free incision made along the border of the sacrum, and penetrating to the pelvis. The incision commences at the posterior superior spine, and ends midway between the anus and the tuber ischii.

Zuckerkandl follows the left border of the sacrum in performing this operation, and Wölfler follows the right. Wölfler in addition removes the coccyx.

4. EXCISION OF THE RECTUM BY THE PERINEO-ABDOMINAL METHOD.

In this procedure, which has not yet been reduced to a fully formulated operation, the rectum is excised partly through the perineum and partly through an abdominal incision. The abdomen is opened in the median line and the whole rectum is detached. Care is taken not to disturb the blood supply of the sigmoid flexure. With the rectum is detached the mesorectum and any glands which may be discovered in connection therewith.

The separation of the bowel is carried as far down into the pelvis as is possible, and every preparation is made for the opening of the peritoneum through the perineum.

When such separation is completed (and if the patient be in the Trendelenburg position it can be carried very far down), the rectum is divided well above the growth and between two ligatures. Care is taken to prevent any extravasation, and the ends of the bowel are at once cleansed and covered with gauze soaked in 1 in 2,000 perchloride of mercury solution.

The patient is now placed in the lithotomy position, and the anal part of the rectum is set free, as in the operation by the perineal route. The sphincter and anus should be spared whenever possible. The peritoneum is in due course reached, and the excised portion of bowel, when free, is withdrawn by way of the perineum. In this step of the operation the surgeon is aided by the assistant, who has kept watch over the abdominal wound. The divided end of the sigmoid flexure is now brought down to the anus and

is secured there by sutures. The entire anatomical rectum is removed, and the length of the sigmoid mesocolon allows of the bowel being brought down to the perineum without the least difficulty. The terrible wound left by the sacral operation is avoided, and the excision of the gut is very complete. There is, moreover, no difficulty in bringing the severed bowel down to the anal region.

In October, 1897, I carried out this operation in a female child who was the subject of a congenital narrowing of the whole rectum. This had resisted all treatment, and a colotomy had been rendered necessary in January, 1897. I removed the whole rectum together with the sigmoid flexure and descending colon, and brought the transverse colon down to the anus, where it was attached. The patient made a perfect recovery.

The specimen is preserved in the Royal College of Surgeons Museum (Specimens 2567, A and B).

COMMENT UPON THE OPERATION OF EXCISION OF THE RECTUM.

The operation for the removal of well-defined epitheliomata of recent standing in the anal region calls for no comment.

It is an excellent measure, which should be carried out in every instance as soon as the growth is discovered.

No exception can be taken to the excision of a cancer of the rectum by the perineal route when the growth is low down, is in an early stage, is entirely limited to the bowel wall, and can be thoroughly and entirely isolated. The mortality in cases of perineal excision would appear to be about 7 per cent.

Considerable differences of opinion, however, exist as to the value of the more extensive operations for the excision of the rectum, and the discussion of these measures may be considered to centre around the operation of excision by the sacral route—the procedure very generally known as Kraske's operation. To this measure the following comments will apply:—

In favour of the operation it is to be pointed out that a malignant growth is removed, and that the operation aims at a complete cure. A colotomy, on the other hand, only deals

with one symptom of the malady—the obstruction of the bowel, and leaves the actual disease entirely untouched.

In favour of the operation it has to be pointed out that the malignant growth which is the subject of the excision is an epithelioma, that a very large measure of success attends the removal of epitheliomata in other parts, and that that success is pronounced in connection with the free removal of involved portions of the left colon, as, for example, in the excision of the sigmoid flexure for early cancer.

Again, in favour of the operation it must be noted that gland implication occurs very late in connection with rectal cancer, and that metastases are met with only at a quite late period in the disease. It would appear, then, that if a free excision could be carried out at an early period, a complete cure should follow. To secure so admirable an end, an operation of no little severity would be justifiable. The records of the operation show that patients have lived for six, ten, and twelve years after the excision without exhibiting any sign of recurrence.

The arguments which must be used against the operation are these:—It is a serious, difficult, and dangerous operation. So far as one can judge from the collections of published cases, the death rate will be between 15 and 20 per cent.

The deaths have been due, for the most part, to shock, hæmorrhage, cellulitis, and peritonitis. That the duration of life has been extended in those who have survived the operation admits of no doubt, and it is also certain that patients have exhibited no recurrence at the end of ten years and more. On the other hand, it would appear that a recurrence takes place in the majority of the cases, and that a permanent cure is comparatively rare.

That free removal which is essential to the success of an excision operation for cancer is difficult to carry out in dealing with the rectum. It is seldom that cases in an early stage are found: it is remarkable, indeed, how advanced the growth usually is when first discovered. Patients may have symptoms of bowel trouble for months before they reach a grade compelling them to consult a medical man. Not only are the cases few which present themselves at a quite early period, but in any example

—not in the commencing stage—it is not always possible to determine from digital examination the exact limits of the growth. Over and over again the growth is found at the operation to be more extensive than was suspected, and to have invaded the tissues to a wider degree than was supposed; over and over again it has to be allowed that the operation was undertaken too late, and that the condition found leaves very little hope of a successful excision. It is rare, indeed, for the surgeon to find upon exposing the part at the operation that the disposition of the growth is more favourable than he anticipated.

In the sacral operation it is not always possible to ascertain whether the pelvic glands are involved, and an excision may be carried out and diseased glands be left behind. There will be few who will dispute the assertion that in a very large proportion of the cases the operation has been done too late.

Another grave objection to the operation is concerned with the state of the patient after the excision. This is often deplorable. The wound suppurates, there is a foul chasm in the perineal and sacral regions, and later on sinuses and fistulæ may form which may extend far and wide. There may be complete loss of control over the anus, such as it is; there may be contraction and obstinate stricture; and, indeed, the patient's state may be from one reason or another one of utter misery. Before he has in any way become accustomed to his deplorable condition, the disease possibly recurs, and there must be presented to the mind the reflection that there is a difference between the quantity of life and the quality of it.

I am not unaware of the undoubted fact that the patient may escape all or many of the discomforts first named. In some cases it is stated that perfect control was obtained over the anus, and in others that such control was possible except when the motions were loose. In a proportion of examples the wound has healed well and without trouble, but it would appear that these excellent results are not present in the majority of the cases operated upon. In the majority there is a degree of discomfort which may vary from mere misery to intense distress. As neither a cure nor a considerable prolongation of

life can be promised from the operation, the patient must frequently be haunted by the doubt whether the operation was worth the doing.

Indeed, excision of the rectum—taking the sacral method as the type of the operation—is a procedure which fails to reach the high standard of excellence which can be claimed for the great majority of modern surgical operations, and the surgeon must well weigh the probabilities and the claims of the procedure before he undertakes it.

The criticism which suggests itself at this stage of the development of the operation of excision of the rectum is the following.

An operation which fails to remove every particle of a malignant growth is always to be deplored, and in few situations is such failure more disastrous than it is in the case of the rectum. A recurrence can scarcely be dealt with, and therefore the utmost care and precision should be exercised in the selection of cases for operation. So far as the records of cases extend, there is a strong suggestion that in many instances the operation has been performed too late, and that the malignant growth has not been excised with such completeness as is essential. The anatomical position of the rectum is, unfortunately, very ill adapted for a theoretically perfect excision of a cancerous growth.

As to the operation itself, it would appear that the one essential feature (after that of complete excision) is the bringing down of the divided bowel to the anal orifice and the firm securing of it in that position. If the anus and sphincter can be left with absolute safety, then the operation may claim to be as nearly perfect as is possible. I am of opinion that if in any case it be found after the excision that the divided bowel cannot be readily brought down to the anus, a permanent colotomy opening should be established in the groin, and the severed end of the bowel below the colotomy opening should be entirely closed by a double or treble row of sutures. In such case there should be no trouble with the healing of the large sacral wound, and the patient exchanges the certain discomfort of a permanent artificial anus in the groin for the

uncertain, dangerous, and varied discomfort which may attend a deep sacral wound that is freely infected with faecal matter.

I am disposed to think that the advancement of the operation will probably be in the line of the perineo-abdominal method. That procedure allows of a perfect examination of the affected part and of a very liberal removal of the possibly implicated tissues around the gut.

It allows of the removal of glands, it simplifies the freeing of the rectum about and below the line of the reflected peritoneum, it renders the treatment of divided vessels open and satisfactory, and it enables the bowel—as represented by the sigmoid flexure—to be brought down with certainty to the anus.

More of the bowel would be removed than is absolutely necessary, but such an element in an operation is not out of place where the removal of cancer is concerned. The loop of the sigmoid flexure—in all but a few exceptional cases—is well adapted for the essential measure of readily bringing down the severed end of the gut to the surface of the perineum of the undisturbed anus.

If any abnormality exists in the sigmoid flexure, it can be ascertained readily as soon as the abdomen is opened. If that abnormality be such as will prevent the bowel from being brought down to the perineum, then the measure may be abandoned before any other than an exploratory incision has been made.



Part XIV.

OPERATIONS ON THE HEAD AND
SPINE.

CHAPTER I.

OPERATIONS ON THE SKULL AND BRAIN.

THE operations here dealt with include those carried out for the relief of depressed or splintered fracture of the skull, for the evacuation of pus or blood between the dura mater and the bone, for the removal of cerebral tumours, for the evacuation of abscesses of the brain or cerebellum, and for the removal of foreign bodies (such as bullets) from within the skull.

In the present category is included the operation of opening the frontal sinuses, and of evacuating the antrum of the mastoid.

The term trephining is not used always in a very precise sense. In the operation which is usually termed "trephining for depressed fracture of the skull" the trephine is, in many cases, not used, but the necessary opening in the skull is made by removing loose fragments, or by cutting away projecting parts of the bone with Hey's saw, the chisel, or the rongeur.

Anatomical Points.—*Position of the Sutures.*—The bregma, or point of junction of the coronal and sagittal sutures, is in a line drawn vertically upwards from a point just in front of the external auditory meatus, the head being in normal position. The lambda, or point of junction of the lambdoid and sagittal sutures, lies in the middle line, about two inches and three-quarters above the occipital protuberance. The lambdoid suture is fairly represented by the upper two-thirds of a line drawn from the lambda to the apex of the mastoid process.

The coronal suture lies along a line drawn from the bregma to the middle of the zygomatic arch. On this line, at a spot about on a level with the external angular process of the frontal bone, and about one inch and a half behind that process, is the pterion. The summit of the squamous suture is one inch and three-quarters above the zygoma.

The Thickness of the Skull varies greatly, not only in different parts of the same skull, but also in corresponding parts in different individuals. The average thickness is one-fifth of an inch. The thickest parts are at the occipital protuberance (where the section may measure half an inch), the mastoid process, and the lower part of the frontal bone. The bone over the inferior occipital fossæ is very thin, while it is thinnest at the lower part of the temporal fossa. Here the bone may be no thicker in parts than a visiting-card. The skull is also thinned over the sinuses and the grooves for the meningeal vessels. It is important to remember in trephining that the inner table is not always parallel with the outer.

The Middle Meningeal Artery is a frequent source of bleeding after fracture of the skull. This vessel, having passed through the foramen spinosum, divides into two branches; the anterior—the larger—runs upwards across the anterior inferior angle of the parietal bone; the posterior runs backwards, with a horizontal sweep, across the squamous bone.

The branches of the artery are more frequently ruptured than the trunk, and a laceration of the vessel as it crosses the anterior angle of the parietal bone is very common.

The Relations of the Brain to the Skull.—Into this subject it is unnecessary to enter in a work like the present. It is needless to say that in dealing with troubles involving the brain very precise localisation is all-essential.

The diagram shown in Fig. 457 depicts the relations of the chief sutures and convolutions, as defined by Dr. Reid. As in the following pages allusion will often be made to "Reid's base line," it may be said that this is a line drawn across the skull from the inferior margin of the orbit backwards through the centre of the external auditory meatus (Fig. 457).

The positions of the two great fissures may be indicated.

The Fissure of Sylvius.—A line is drawn from a point one inch and a quarter behind the external angular process (Fig. 457, r) to a point three-quarters of an inch below the most prominent part of the parietal eminence (x). The first three-quarters of an inch of the line will represent the main fissure, and the

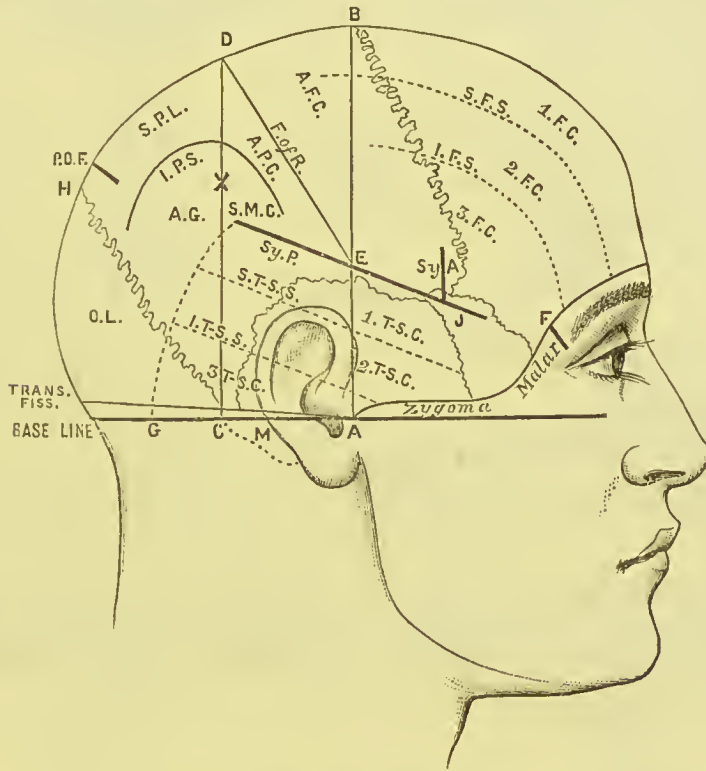


Fig. 457.—DIAGRAM TO SHOW THE RELATIONS OF THE BRAIN TO THE SKULL.
(Modified from Reid.)

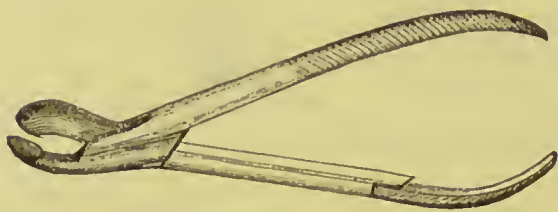
J.B., coronal suture; B, bregma; F, external angular process; H, lambda; H.C, lambdoid suture; J, pterion; M, mastoid process; X, parietal eminence; Sy.A, sy.P, anterior and posterior limbs of Sylvian fissure; F, of R, fissure of Rolando; A.F.C, A.P.C, ascending frontal and ascending parietal convolutions; S.F.S, I.F.S, superior and inferior frontal sulci; 1 F.C, 2 F.C, 3 F.C, frontal convolutions; S.T-S.S, I.T-S.S, superior and inferior temporo-sphenoidal sulci; 1 T-S.C, 2 T-S.C, 3 T-S.C, temporo-sphenoidal convolutions; I.P.S, intraparietal suture; S.P.L, superior parietal lobule; S.M.C, supramarginal convolution; A.G, angular gyrus; P.O.F, parieto-occipital fissure; O.L, occipital lobe. *See also text.*

rest of the line will indicate the horizontal limb. The ascending limb will start from the anterior end of the line indicating the main fissure, and run vertically upwards for about one inch (Fig. 457, sy.A).

The Fissure of Rolando.—From the base line draw two vertical lines upwards—one (Fig. 457, A B) from the depression in front of the meatus, and another (C D) from the posterior

border of the mastoid process at its root. There is thus formed a four-sided figure, bounded above and below by the median line and the horizontal limb of the Sylvian fissure respectively, and in front and behind by the two vertical lines. A diagonal line (D E) drawn from the posterior superior angle to the anterior inferior angle of the space will be over the fissure of Rolando.

The fissure of Rolando may also be determined in the following manner:—From the depression at the root of the nose measure $\frac{1}{2}\frac{1}{0}$ of the distance between it and the external occipital protuberance along the median line. This will correspond



[Fig. 458.—HOPKINS'S RONGEUR.]

to the upper end of the fissure, which runs at an angle of 67·5 degrees (three-fourths of a right angle) downwards and forwards.

The situation of the chief convolutions is indicated in Fig. 457. In this matter the surgeon should consult Professor A. Frazer's admirable "Guide to Operations on the Brain," and Sir W. Macewen's elaborate "Atlas of Cerebral Topography."

TREPHINING IN FRACTURE OF THE SKULL.

Instruments Required.—Trephines of various sizes; a quill; a pair of Hey's saws; a small pair of bone-cutting forceps; slender chisel and mallet; a gouge; a pair of gouge forceps, such as Hopkins's rongeur (Fig. 458), or Hofmann's modified form; an elevator; periosteal rugine; necrosis forceps; scalpels; dissecting and Wells's forceps; scissors; dressing forceps; fine-toothed forceps, and fine scissors for the dura mater; small tenaculum or slender curved needle in a handle for bleeding vessels; probe; needles and sutures.

Trephines are made in various sizes; one with a crown three-quarters of an inch in diameter is the most convenient. The so-called "old-pattern" trephine is shown in Fig. 459.

It has been replaced by more suitable instruments. American surgeons largely employ the conical or Galt's trephine (Fig. 460). It is claimed that the instrument is steadier and

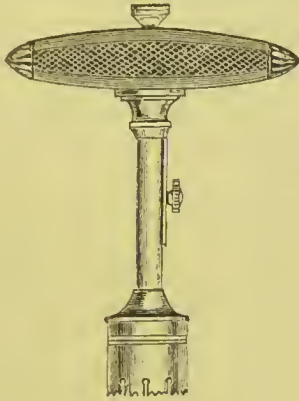


Fig. 459.—OLD-PATTERN TREPHINE.



Fig. 460.—CONICAL TREPHINE.

safer, since it is almost impossible for it to be driven on to the brain when the last portions of the inner table give way unexpectedly. This accident has happened with the old-pattern trephine. Horsley employs a trephine for operations upon the

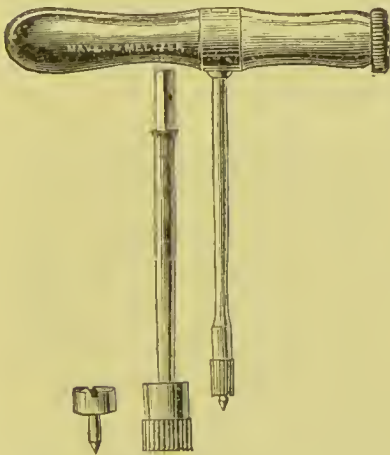


Fig. 461.—TREPHINE OF SIR VICTOR HORSLEY'S PATTERN.

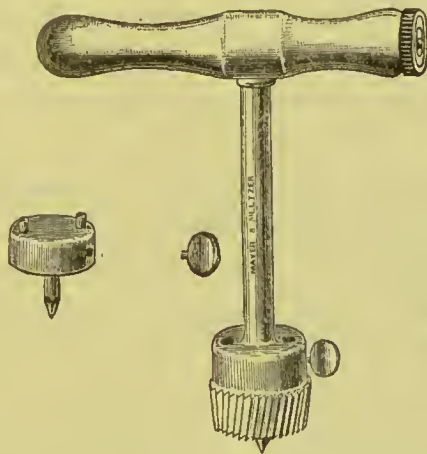


Fig. 462.—ASEPTIC TREPHINE WITH DETACHABLE CENTRE-PIECE.

brain which is provided with a very convenient handle (Fig. 461). It has also such a thin cutting edge that the buttons of bone when replaced fit much better than when cut by the more substantial instrument.

The so-called Aseptic Trephine (Fig. 462) has a detachable

centre-piece carrying the pin. This centre-piece is fixed in position by a small screw; after the outer table has been well grooved the screw and centre-piece are removed.

The rongeur is of great service in cutting away projecting rims of bone, and in smoothing sharp edges.

A fine chisel may be employed for the same purposes by those who are familiar with the use of this instrument.

All the instruments must be sterilised, and are placed in a tray containing sterilised water until used.

Preparation of the Patient.—The head is shaved, then washed with soap and water, and scrubbed with a nail-brush. It is next washed with ether, and finally with a 1 in 20 solution of carbolic acid in alcohol, or the 1 in 500 alcoholic solution of biniodide of mercury. As the operation may be urgently required and little time be available for preparation of a germ-laden scalp, the use of an alcoholic solution of carbolic acid, carbolate of mercury, or biniodide must be vigorous and thorough. In operations that are not of an urgent character the usual antiseptic compress should be worn for some twelve hours before the operation. Such preparation is possible in most cases of operation upon the brain.

The head is conveniently supported upon a sand-bag covered with macintosh sheeting and sterilised towels.

Chloroform will be the anæsthetic probably selected. In some cases of depressed fracture no anæsthetic is required.

The Operation.—When any wound already exists, the fracture is exposed by enlarging it as required. When the scalp is sound, a semilunar flap may be raised, the free end of which points vertically downwards. It should form a shallow curve, and be so planned as to avoid the main scalp arteries.

Or a V-shaped incision may be employed, with the apex of the V pointing downwards. In any case, the flap should be of ample size, and should be so placed as to allow of the free draining away of blood.

The incision should be carried at once down to the bone, and the pericranium having been detached with a curved rugine, the flap as it is turned up will be composed of all the soft parts covering the skull.

A long silk suture should be inserted into the free end or apex of the flap, and by means of this thread the flap is drawn up, and held out of the way.

The bleeding from the scalp tissues is usually free. The more conspicuous bleeding points are neatly secured by pressure forceps; sponge pressure will check mere oozing.

The fracture is now exposed and examined. It may be found to be at once possible to introduce an elevator beneath the depressed bone, and to elevate it. Fragments at the same time may often be readily removed by means of dressing forceps or necrosis forceps.

In other cases a rim of projecting bone—belonging to the sound part of the skull—may be removed with a narrow chisel and mallet, or with Hey's saw, or with the gouge or gouge-forceps, and a little space is at once provided between the bones

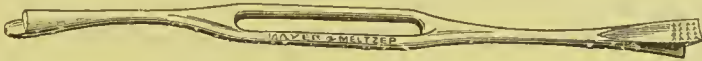


Fig. 463.—ELEVATOR FOR THE SKULL, WITH HEEL WHICH ACTS AS A FULCRUM.
(*Sir Victor Horsley's pattern.*)

which will allow of an elevator being introduced. In this part of the operation it must be confessed that Hey's saw is of little use. Indeed, Hey's saw is not a serviceable instrument, and it is rarely employed.

The elevator must be introduced with care. It is apt to slip, and such an accident is least possible with Horsley's instrument (Fig. 463). In raising the depressed bone, it is needless to say that the elevator must be supported upon the sound part of the skull.

Sometimes when the bone is much comminuted one fragment will be found to be so tilted outwards that it can be seized and removed, and through the gap thus left the elevator or the blade of the dressing forceps or necrosis forceps can be introduced.

In a comparatively few cases the trephine will be needed. The centre-pin of the instrument is introduced; the crown is then applied to the sound bone near to the fracture. As a rule, it is so applied that two-thirds or three-fourths of the

circle will be upon the sound skull, and the remaining third or fourth over the fractured area. The trephine should not be placed so far over the injured area as to produce trouble by jarring any fragment which may be lying in contact with the dura mater.

The point is bored into the bone, and then the trephine is made to cut into the skull by light sharp movements from left to right, and from right to left.

At first the instrument may be steadied by the left forefinger, which rests upon the skull. As soon as a groove has been cut all round, the pin may be withdrawn, and the instrument will be found to maintain a steady hold of the part. The pressure must be evenly maintained throughout, and will be found to be chiefly exercised when the hand is turned from left to right (the supination movement). At first the bone-dust is dry, but as soon as the dense outer table is cut through it becomes soft and bloody. As the trephine enters the diploë the softer character of the resisting medium is at once recognised.

The wound in the bone must be kept constantly clear of dust by frequent irrigation and the use of the quill. The trephine itself is rinsed in warm sterilised water from time to time, to free it from *débris*. Those who have only experimented with the dry skull of the cadaver will be surprised at the ready manner in which the trephine cuts its way into the living bone. The depth of the groove in the skull must be estimated from time to time with the quill. Inasmuch as the skull is spheroidal, it is exceedingly difficult to make the groove of equal depth all round. The shallower parts must be especially cut down to the level of the deeper parts, by bearing pressure upon the bone at the points where the division has been less complete. As the inner table is penetrated, increased caution must be exercised, and still more care is needed when once the groove has been extended right through the skull. It must be remembered that the bone will probably be of unequal thickness even over the small area covered by the trephine.

When the groove is of sufficient depth, the disc of bone may be removed by gently rocking the trephine to and fro while it is still in position, or by cautiously introducing an

elevator at a spot where the bone is entirely divided. Not unfrequently the disc of bone can be grasped with forceps, and lifted out. In any case, some little portion of the inner table will have to be broken through.

Should any portions of the inner table be left behind, they can be removed by the elevator or the cutting gouge.

In removing large discs of bone it is important that the dura mater be carefully stripped from the inner table as the button is being cautiously lifted up with the elevator.

The trephine disc, if it is to be replaced, may be at once put in a china receptacle containing a warm solution of corrosive sublimate (1 in 2,000), and maintained at a temperature of 100° F.

In the case of a punctured fracture it is well to employ an inch trephine, and to let the pin of the instrument fall near to the puncture, in order that the whole of the damaged area may be removed, and the possibly wide-spreading comminution of the inner table be fully exposed. This particularly applies to the fracture caused by the points of entry of a small calibre bullet such as the Mauser. The aperture of exit of such missiles will, as a rule, not need the trephine.

If in any case the hole made is not sufficient for the purpose, it may be enlarged by means of the rongeur, the chisel, or a fresh application of a smaller trephine to an adjacent segment of bone.

In all cases every splinter and loose fragment of bone must be cautiously removed. Depressed fragments which still retain a hold upon the sound bone are left in position after they have been elevated.

The edges of the opening in the bone are finally smoothed off with the rongeur or the gouge.

The treatment of any hæmorrhage that may arise is dealt with on page 734.

The trephine disc or any large fragment of bone which has been preserved may be replaced as nearly as possible *in situ*.

The replacing of the trephine disc or of large fragments of bone is not necessary, and should only be resorted to when the portion removed is very large and when the scalp at the

time of the operation was intact. Such replacing of portions of bone should not be practised in cases of compound fracture, as infection is more than probable.

The flap or flaps of scalp are now brought into place by silkworm-gut sutures, and drainage is secured by introducing a bunch of horsehair threads here and there between the stitches or by a slight gauze drain. The skin is well cleansed, the wound is dusted with iodoform, and a suitable dry dressing is applied and is secured by means of a tight flannel bandage.

Complications.—When the dura mater has been wounded, it should be carefully sutured with the finest catgut whenever possible.

Hæmorrhage throughout the course of the operation may be free, but it seldom gives much trouble. Oozing from the diploë, as a rule, soon ceases spontaneously. Should one of the diploic veins have been cut across, and bleed persistently, in spite of sponge pressure, a little of the bone tissue around the divided vessel may be crushed into the mouth of the opening by means of the point of an elevator. Bleeding from the dura mater, if obstinate, may need to be checked by a fine catgut ligature. The vessel will have to be picked up, most probably by means of a delicate tenaculum.

Hæmorrhage from the middle meningeal artery is dealt with on page 735.

If bleeding take place from a sinus, pressure should at once be applied by means of a piece of aseptic gauze. Mr. Jacobson points out that bleeding from even a large venous sinus is readily arrested by quite moderate pressure. The gauze may need to be kept in position for some time, and in extreme cases has been left *in situ* for two or three days. In several instances hæmorrhage from a sinus has been arrested by lateral ligatures, and cases are recorded in which lacerations of both the superior longitudinal sinus and the lateral sinus have been successfully treated by this means.

“Certain precautions must be observed,” writes Dr. Nancrede, “when the fracture is near a sinus which we suspect has been wounded by depressed fragments. Thus the trephine-cut must be planned so as to give access to any bleeding point

rather than merely to admit easy elevation of the fragment. One is often tempted to draw out a long fragment driven some distance beneath sound bone, whose concealed extremity lies in close proximity to a large sinus, possibly wounding it. . . . In such case it is far safer to trephine over the site of the concealed extremity of bone, when, if its withdrawal is followed by hæmorrhage from a wound of the sinus, instant compression may be effected."

When in certain cases—probably cases of operation for disease—it appears imperative to trephine over a sinus, two smaller trephine discs should be removed from either side of the sinus, and the intervening bridge of bone be then cautiously cut away.

The **after-treatment** is considered on page 748.

TREPHING FOR MIDDLE MENINGEAL HÆMORRHAGE.

The whole subject of hæmorrhage from the middle meningeal artery has been thoroughly dealt with by Mr. Jacobson in a most able article published in the *Guy's Hospital Reports* for 1886. So far as operative interference is concerned in cases of intracranial hæmorrhage, it is practically limited to blood collections arising from rupture of this artery.

The artery crosses the anterior inferior angle of the parietal bone at a point one inch and a half behind the external angular process of the frontal bone, and one inch and three-quarters above the zygoma. These measurements apply to the adult skull. Mr. Jacobson advises that the centre of the wound made for the trephine should be on a spot one inch and a half behind the external angular process, and one inch above the zygoma.

Krönlein recommends the following guides for the application of the trephine (*Deutsche Zeitschrift für Chirurgie*, 1886, *Hefte 3 und 4*). Unless specially contra-indicated by some very decided localising symptoms, which point to a collection of blood pressing upon a definite centre, the trephine-holes should be determined thus:—A line is drawn around the

skull at the level of the upper margin of the orbit, and is throughout parallel with Reid's base line (Fig. 464). (See also page 726.) The trephine is first placed at a spot upon this line, which is from one inch and a quarter to one inch and a half, according to age and the size of the head, behind the external angular process of the frontal bone (Fig. 464, A).

Should the opening reveal no blood clot and no bleeding vessel, a second trephine-hole is made upon the same line,

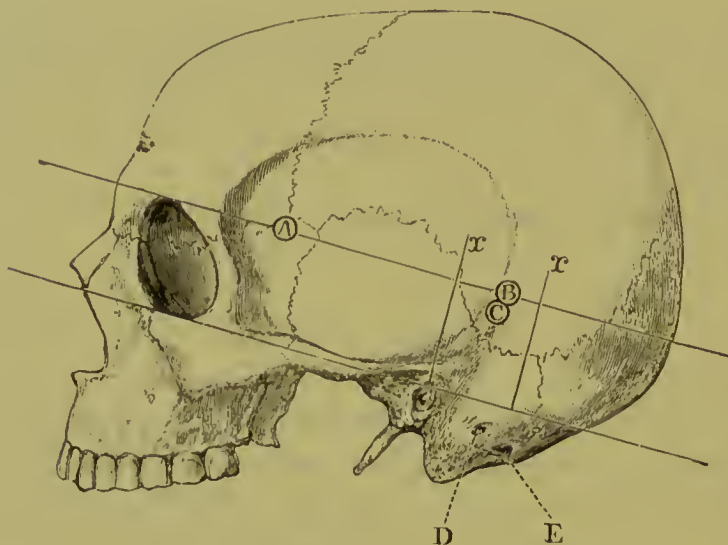


Fig. 464.—POINTS FOR TREPHINING.

A, B, spots for trephining in middle meningeal hæmorrhage; C, spot for trephining in abscess of the temporo-sphenoidal lobe; E, spot for trephining in abscess of the cerebellum; D, mastoid foramen. See also page 741. (After Nancréde.)

just below the parietal eminence, and at a point where a vertical line, carried up from the posterior border of the mastoid process, bisects the horizontal line already indicated (Fig. 464, B).

When any external injury or fracture of the skull exists, this should be first explored. The hæmorrhage will very probably be found beneath the damaged bone, and one operation may suffice to elevate depressed fragments and to allow extravasated blood to escape.

In many cases no anæsthetic is required.

The operation of opening the skull is carried out precisely in the manner already indicated.

The clot, when exposed, is removed by forceps, or a small scoop, aided by free irrigation.

If bleeding continue, any accessible vessels in the dura mater should be secured by catgut ligatures, passed by means of a fine curved needle. Single bleeding points have been checked by a touch from a red-hot probe. Bleeding from the trunk of the middle meningeal artery, as it lies in its bony canal, may be arrested by plugging the canal with a little strip of gauze.

More general oozing, or such hæmorrhage as arises from inaccessible sources, may be dealt with by the application of ice to the skull, or by pressure maintained by plugging the wound with sterile gauze. In a few instances a ligature of the external or common carotid artery has been deemed necessary, and has been carried out with success.

The operation is concluded as already described. The question of drainage is alluded to on page 748. It is possible in some instances that efficient drainage cannot be obtained through the trephine-hole already made; and in such case Dr. Nancrede advises that another bone perforation be made for the purpose at the most dependent portion of the cavity.

Weisemann has collected a series of cases which show that of 147 cases of intracranial hæmorrhage treated by the expectant plan, 131 died, or about nine-tenths; while of 110 cases treated by operation, only 30 died, or about one-third (*Deutsche Zeitschrift für Chirurgie*, 1885).

For the **after-treatment**, see page 748.

TREPHINING IN CASES OF BULLET WOUND.

Into the complex subject of the treatment of gunshot wounds of the brain it would be out of place to enter.

The chief end effected by the surgeon in a large number of cases consists in a liberal trephining at the point of entry, in removing all loose fragments and spicules of bone, in getting rid of blood clot and in providing free drainage. His chief object does not consist in hunting for a foreign body, the position of which is unknown. It is a question which can do the more harm—a motionless bullet (which may in time become encysted)

or a probe, which is driven hither and thither through the brain substance.

The exact localisation of the bullet has been rendered comparatively easy by the use of the Röntgen rays, which should always be used before attempting any operation. The telephone-probe may also be found of advantage.

If there be a wound of exit it also should be exposed and dealt with upon the lines indicated, although the use of the trephine in this position is seldom demanded.

TREPHINING FOR EPILEPSY AND OTHER CEREBRAL TROUBLES OF CORTICAL ORIGIN.

As a method of treatment of ordinary epilepsy, trephining is useless. It is only in those cases in which the convulsions are of the so-called Jacksonian type that it is worth trying. The most hopeful cases are those in which a group of muscles on one side of the body only are first attacked by the convulsive seizure, and in which there is evidence of past injury over the centre corresponding to the movements of such muscles. It may be that the removal of an area of thickened bone or dura, or the evacuation of a traumatic cyst, will suffice to cure, or at any rate relieve, such a case of post-traumatic epilepsy. Unfortunately, even when the localisation has been of the clearest the surgeon may find no evidence of disease at the time of operation, and by some the results of trephining are considered so disappointing as hardly to justify further trial. In the hope of improving these results, especially where no obvious lesion in bone or dura is found, Sir Victor Horsley has recommended and carried out excision of that part of the cerebral cortex which corresponds to the predominant muscular spasm ("the epileptogenic centre").

After the dura has been incised, in order to localise the centre, the electrodes of an induced current battery are used to the cortex. By this means spasmodic movements are obtained, and the centre is mapped out which it is desired to excise. Great care must be taken as to asepsis, and, if possible, the dura mater (which has been reflected in a flap) should be sutured

in place again. If hæmorrhage from the cortical wound persists it is best to provide for drainage at one corner of the flap. The risk attending an operation so extensive as that described is considerable, even with careful aseptic precautions; and it is impossible to give a true estimate of its value as a curative measure, since it has only been practised for a few years. In one of the latest papers on the subject (Langenbeck's *Archiv*, 1902, vol. lxxvii.) a Russian surgeon, Rasumowsky, narrates seven such cases of traumatic epilepsy operated on by himself after Horsley's method, including excision of the cortical centre. In each case an osteo-plastic flap was turned down and replaced at the end of the operation, the dura being sutured. Galvanism was used in the manner described. One patient died of late septic infection, and in two of the remaining six the convulsions entirely ceased. In one some improvement followed, whilst in three the operation entirely failed.

Speaking generally of the results from operation on cases of post-traumatic epilepsy, this percentage of cures—viz. 25 per cent.—may be taken as rather favourable.

That a few cases are benefited for long by the operation cannot be doubted. In one of Sir V. Horsley's cases trephining and excision of the scarred portion of the motor area has been followed by cessation of the fits for fourteen years. This is the longest period yet recorded.

It may be emphasised that favourable results can only be expected from operation (1) if the epilepsy is of the Jacksonian type; (2) if it has followed an injury to the head; (3) if this injury has implicated the motor area of the cortex, on either side of the fissure of Rolando; and (4) if the operation be conducted under strict asepsis and the part excised includes the scar and surrounding "unstable" portion of cortex.

It is obvious that a certain degree of paralysis will follow the operation according to the extent of the excision, but improvement may in time take place.

Sir Victor Horsley has never known a case in which the frontal region of the brain had been implicated improve after operation, nor is the prognosis much better when the sensory area—occipital and temporo-sphenoidal lobes—are concerned.

Operation on cases of congenital cysts within the cranium will only give good results if done in early life. In one case operated on by me (J. H.) the convulsive seizures shortly before the operation were almost continuous. Immediate relief followed the evacuation and drainage of a subdural cyst, and at the end of a few weeks the man appeared to be cured. Subsequently, however, he died from a recurrence of the convulsions.

In cases of hystero-epilepsy no operation of any sort should be performed.

Trephining with free removal of bone has been tried in several inveterate cases of cephalalgia—*i.e.* those which have resisted all medical treatment. The results have been much more encouraging than in traumatic epilepsy. Trephining was suggested for general paralysis, and had in the treatment of this disease a brief and inglorious career.

TREPHINING FOR ABSCESS OF THE BRAIN.

When the abscess of the brain is the result of injury, or depends upon the lodgment of a foreign body, the situation of the external lesion and the nature of the symptoms may serve to indicate the probable position of the purulent collection.

In any case, when the trephine has been placed over the most probable spot, and no abscess has been exposed, the necessity for multiple trephining may be obviated by the use of a long trocar and cannula, or a slender aspirating needle (the former is to be preferred, as the latter is liable to be blocked in passing it through the cortex, etc.). The pus is certain to be under tension, and will probably spurt out if the abscess be struck. The cannula must be always introduced with the trocar in it; but if no pus is found at a certain depth, the cannula should be slowly withdrawn, as it may chance that a small abscess has been completely traversed. After puncture in one direction has failed, it should be repeated in another, but there should be no aimless thrusting, as, of course, the less mechanical injury inflicted on the delicate brain-substance the

better. Sudden death has occasionally resulted from exploring puncture made in the direction of the medulla or Pons Varolii. The instrument must be pushed in in a direct line at each examination. There must be no lateral movement of it, and no attempt to pass it from one point of the brain to another without removing it and re-introducing it.

In many instances the abscess of the encephalon is dependent upon suppurative disease of the middle ear. The pus in these cases is very commonly found in the temporo-sphenoidal lobe, and next in frequency in the cerebellum. It is estimated that cerebral abscess following middle ear disease is three times as common as cerebellar.

Mr. Barker states that nine-tenths of the abscesses in the temporo-sphenoidal lobe occupy a space three-fourths of an inch in diameter, whose centre is one inch and a half above and the same distance behind the centre of the external auditory meatus (*Brit. Med. Journ.*, 1887, vol. i., page 407).

Such an abscess of the temporo-sphenoidal lobe is usually found (according to Mr. Barker's researches) between two lines drawn at right angles to Reid's base line. These lines are about one inch and a quarter apart; one passes through the meatus, the other about one inch and a quarter behind that opening (Fig. 464, *xx*).

The trephine should be introduced in the centre of the space marked out by these two lines, and at a distance of about one inch and a quarter above the base line (Fig. 464, *c*).

A needle introduced through such an opening should be thrust inwards, forwards, and a little downwards.

In dealing with an abscess of the cerebellum, the best spot to select is, in the adult, one inch and a half behind the centre of the meatus, and one inch below the base line (Fig. 464, *e*).

Mr. H. P. Dean has pointed out that it is possible to expose the lateral sinus and the dura mater over the lower part of the temporo-sphenoidal lobe and the cerebellum through the same trephine aperture. The pin of the trephine should be placed one and a half inches behind and half an inch above the centre of the external auditory meatus. If the wall of the sinus appears quite normal, it should be left alone and the temporo-

sphenoidal lobe explored; if no pus is let out the puncture should be repeated into the cerebellum with a downward and inward direction. This method may obviate the necessity for making two separate trephine holes, but it has the drawback that the lateral sinus is very apt to be opened by the trephine, as the piece of bone removed is of very unequal thickness. Nevertheless the method is a valuable one in certain cases in which it is doubtful whether there is an intracranial abscess or purulent thrombosis of the lateral sinus.

The Operation for Cerebral Abscess.—The trephining is carried out in the manner already described. In dealing with an abscess in the temporo-sphenoidal lobe, a triangular flap, with its base above and behind, will be found to be convenient. This is held up by means of a ligature inserted into its apex.

The dura mater is exposed, and will usually be found to be without pulsation, and to bulge into the trephine-hole. This change in the membrane is a certain sign, not necessarily of pus, but of increased intracranial tension.

The dura mater is incised with the scalpel, and is then opened by the aid of fine scissors and delicate-toothed forceps. The division should be so made as to render the subsequent closure of the rents with sutures possible. A crucial incision will probably be the most convenient. The aspirating needle having been introduced and pus discovered, the next step is to insert a pair of slender sinus forceps by the side of the needle, and thus to enlarge the track along which the pus may escape.

Along the passage thus made a drainage-tube of indiarubber or of silver is introduced. Mr. Barker advises a silver tube, provided with a proper flange or shield, and of the diameter of a No. 8 catheter. The silver tube, however, is rarely at hand when the operation is performed, and rubber answers well, as it allows of being shortened as required. A double or two-way tube is very convenient for syringing. The length of tube within the skull should measure about one inch. The tube must be secured in place by sutures. The flap is now adjusted, but the sutures may be omitted at the apex of the flap, so that the trephine-hole may not be entirely covered up, but that there may be every opportunity offered for the escape of matter.

The wound is now cleaned and covered with a dressing of loose gauze. The part should be frequently irrigated, and hence the special advantage of the two-way tube.

Any tube is apt to get blocked from time to time, but can usually be cleared without removing it. The rubber tube will be gradually shortened, and the surgeon should not be in great haste to remove it finally, since a re-accumulation of pus may occur. It will probably have to be retained for two or three weeks.

If a branch of the middle meningeal artery be exposed in the trephine-hole, it should be secured between two ligatures before the membrane is divided.

The Operation for Cerebellar Abscess.—The trephining is conducted upon the same lines. The point for the insertion of the trephine has been already indicated (Fig. 464, E). Mr. Barker recommends that the point be reached by means of an incision parallel with Reid's base line, and half an inch below it. The cut starts from the posterior border of the mastoid process, and extends backwards for two inches. Through this incision the superior curved line of the occipital bone is exposed.

All the soft parts, together with the pericranium, are peeled downwards with a rugine until the inferior curved line is reached. Care must be taken not to wound the trunk of the occipital artery. The spot already indicated as most suited for the introduction of the trephine will lie just below the latter line. The bone here is very thin. The lateral sinus lies opposite to the superior curved line above and the mastoid process in front. The spot for the trephine is a little behind and below the mastoid foramen, and the direction in which it should work is upwards and slightly inwards. The bone may be removed with the trephine, or, if more convenient, with the gouge.

The dura mater is incised, the needle is employed, and the abscess is opened and drained in the manner already described (page 742). If the skin and soft parts on being released are found to overlap the trephine-hole, they must be divided in such a way as to leave the latter quite clear.

Mr. Barker recommends that as soon as the bone is exposed the mastoid foramen should be examined. If pus has found

its way along the groove of the lateral sinus, it may induce symptoms akin to those of cerebellar abscess, and an examination of the foramen may reveal pus escaping, since that opening leads direct into the groove for the sinus.

A sufficient enlargement of this foramen to allow of free drainage may render further operation unnecessary.

M. Broca points out that a cerebellar abscess may sometimes be reached after excavating the mastoid antrum through the posterior surface of the petrous bone just in front of the descending portion of the lateral sinus. This is, however, a circuitous route which is hardly adapted for free drainage.

TREPHINING FOR CEREBRAL TUMOUR.

On May 12, 1885, a paper in every way remarkable was read before the Royal Medical and Chirurgical Society by Dr. Hughes Bennett and Mr. Godlee. In this communication an account was given of the accurate diagnosis and the successful removal of a tumour of the brain. The operation was performed on November 25, 1884. The patient lived four weeks. The account of the case forms an admirable exposition of scientific precision and surgical acumen.

From this case cerebral surgery as a practical measure may be said to date.

In the autumn of 1888 Sir William Macewen, of Glasgow, in an address delivered before the British Medical Association, gave an account of a series of successful operations which he had performed upon the brain or its meninges. Among these cases was one of removal of a "syphilitic tumour" from the pre-central lobe. The operation had been performed in June, 1883, and the patient made a good recovery (*Lancet*, August 11, 1883).

These pioneer operations were rapidly followed by many others. The further development and elaboration of the details of cerebral surgery depend mainly upon the genius of Sir Victor Horsley, whose work in this department of practice has been brilliant. In a paper published in the *British Medical*

Journal for December 6, 1890, Horsley gives a table of no less than forty-four cases of operation upon the brain performed by himself. Out of this number, ten died.

It must, however, be admitted that the hopes raised that cases of cerebral tumour could be cured by operation have rarely been borne out by the result. The ordinary form of such growths—sarcoma or glio-sarcoma—is a soft, infiltrating one with no defined boundary. It always recurs after operation, and hernia cerebri is the almost invariable result. Temporary relief from pain is usually met with after the trephining, due to the lessening of intracranial tension. This is unfortunately the most that can be said in favour of operation in the great majority of cases. There is, however, one variety of intracranial tumour which does not infiltrate, and which may be removed with real success—namely, the psammoma of the dura mater. Such tumours form a very small minority of the whole.

Cysts of the brain or its membranes are also occasionally cured by operation.

The following account is based mainly upon Sir Victor Horsley's instructions and descriptions of various operations.

Instruments Required.—In addition to the instruments already mentioned as used in trephining (page 728), the following are employed:—Very large trephines with a diameter of $1\frac{1}{2}$ or 2 inches; a circular saw worked on a Bonwill's surgical engine, or by an electric motor; strong bone-cutting forceps; fine curved needles and a needle-holder for suturing the dura mater; wire serres-fines; scoop or cruceator; sharp spoon; Horsley's flexible knife.

Preparation of the Patient.—The head is shaved and cleansed as already described. The situation of the growth is marked out upon the scalp, and after the anæsthetic has been administered, this surface-marking is transferred to the skull by boring small holes here and there with the finest trephine pin. Very strict antiseptic precautions must be observed throughout.

The Anæsthetic.—A hypodermic injection of morphine is administered, in suitable dose, one hour before the operation.

The anæsthetic advised is chloroform, on the ground that it induces less cerebral excitement. The morphine has the effect of contracting the arterioles of the central nervous system, and hence of lessening hæmorrhage. At the same time, it allows less of chloroform being given.

Scalp Incisions.—A single flap is raised, the outline of which is a shallow curve. It is free below, and is so planned as to avoid the main scalp arteries, and to permit of free drainage when the patient is recumbent. The pericranium is separated by the rugine over the area exposed, and is turned back together with the other structures of the scalp. All bleeding must be arrested before the trephine is applied.

Exposure of the Brain.—This may be effected by the large trephines. An opening may be made at the two extremes of the area to be removed, and the intervening bridge of bone may then be divided by means of Hey's saw or the chisel and mallet. The dura mater during the progress will be protected by a thin metal spatula. All the bone fragments removed are preserved in the manner already described (page 733).

A better way of exposing a large surface of dura mater consists in turning down a flap which includes scalp, pericranium, and the subjacent bone. The flap should be more or less rectangular with its attached base downwards. At each angle a half-inch disc of bone is removed by the conical trephine. A flexible metal director with a broad groove is then carefully introduced from one trephine hole to another, separating the dura mater and pushing it inwards. A hooked probe is now passed in the groove of the director, and by its means Gigli's wire saw is drawn through and the bone divided from within outwards. It is well not to saw very quickly, as the narrow blade may become over-heated or break. Gigli's saw is practically a fret-saw. All the four angles of the bone-flap having been united by the saw-lines, it is turned downwards with its overlying pericranium and scalp.

The dura mater is now divided around about four-fifths of the margin of the aperture in the bone. The incision is made about one-eighth of an inch from the bone, so as to leave room for suturing. The incision may be conveniently commenced

with the scalpel, and completed with slender blunt-pointed scissors.

All arteries lying in the line of the proposed incision must be tied, and this is most readily done by passing the ligature with a fine curved needle in a handle. The brain is now exposed, the flap of dura mater being held aside by a suture passed through its margin.

Removal of the Tumour.—Incisions into the brain must be clean cut, be vertical to the surface, and be directed into the corona radiata when necessary, so as to avoid damage to fibres coming from other portions of the cortex. The growth may be enucleated by means of Horsley's flexible knife, or by a broad hernia director or an elevator. In all cases, adherent or altered dura mater must be excised.

When a portion of brain has been cut away, the underlying cerebral tissue soon bulges up, and obliterates the hollow left by the loss of substance.

Hæmorrhage from the brain tissue is seldom troublesome. The arterioles for the most part run perpendicularly to the cerebral surface. Most of the bleeding is soon checked by sponge pressure, by ice, or by the use of sterilised adrenalin solution. The actual cautery should never be employed to arrest bleeding from the brain. Extensive divisions of surface blood-vessels may be avoided by lifting them out of the sulci between the convolutions, and replacing the pia mater after the tumour has been removed.

The treatment of bleeding from large meningeal arteries and also from the venous sinuses has been already alluded to (page 734).

Closure of the Wound.—The flap of dura mater is brought into place, and is secured to the unwounded part of the membrane by a few fine catgut sutures; space, however, must be left for drainage. The bone discs and portions of skull removed by the saw are now arranged and secured in the manner already described (page 733).

This step can only be taken when the dura mater is intact. If any of the brain area be left uncovered, it is unwise to attempt to replace the lost pieces of bone. The scalp flap is now brought

into place and secured by silkworm-gut sutures, room being allowed for drainage. The drainage-tube reaches to the surface of the wound in the brain, and is placed at the most dependent part of the wound when the patient lies supine. This tube is retained only for twenty-four hours. A voluminous aseptic dressing is then applied.

AFTER-TREATMENT OF CASES OF TREPHINING.

The patient is kept absolutely at rest, and the room occupied should be perfectly quiet. The head is kept a little raised. The wound is dressed upon ordinary surgical principles. In cases of fracture, or in cases of trephining for epilepsy, etc., where no lesion of the dura mater exists, draining by catgut will suffice. In cases of trephining for the removal of a brain tumour, or the evacuation of a cerebral abscess, drainage with a tube is necessary. In the former case the tube is retained for twenty-four hours only; in the latter it is retained until the abscess cavity has practically closed, and is shortened as often as required. In a few instances of intracranial suppuration a second opening in the skull may be necessary to ensure perfect drainage.

If, after the removal of the drainage-tube in any case, pain and throbbing in the wound be complained of, and if the scalp flap appear to be raised up, it may be necessary to reopen the track of the drainage-tube to allow pent-up discharges to escape.

Sutures may be removed at any time after the fifth or sixth day, or be retained as long as appears needful. If a hernia cerebri form, it can best be treated, so far as my own experience goes, by means of a pad of gauze and wool, kept constantly wet with absolute alcohol. The surface of the protrusion hardens, and forms a species of scab or cuticle, which in time becomes quite tough, and affords an efficient covering to the exposed brain.

The patient will need to remain in bed until the wound is soundly healed. From two to three weeks will represent an average time.

The diet is such as is advised after any grave operation.

OPERATIONS ON THE SKULL FOR MICROCEPHALUS AND
HYDROCEPHALUS.

In the first edition of this work an account was given of the operation of "craniectomy" done with a view of allowing the microcephalic brain to expand. The results have been, however, so unsatisfactory that few, if any, surgeons now regard it as a justifiable procedure, and there is no doubt it was founded on an erroneous view of the pathology of the disease. In other words, the skull in these microcephalic children is small because the brain is badly developed and not *vice versâ*. Many ingenious operations have been carried out of late years in cases of hydrocephalus, but the results have been so disappointing that no useful purpose would here be served by describing them; nor do the various attempts at operative cure of hydrocephalus by drainage offer at present the least encouragement to the surgeon to persevere.

OPERATIONS ON THE FRONTAL SINUSES.

The frontal sinuses are opened up with the trephine in certain cases of disease of the lining membrane of those cavities, and especially in such affections as are associated with occlusion of the infundibulum.

In cases of necrosis, also accompanied by the retention of foetid pus, this operation has been carried out with success.

The frontal sinus is an irregular cavity varying greatly in size in different adult subjects. The two sinuses communicate, as a rule, across the median line, the septum being incomplete above. Operation for empyema of the sinus may therefore be necessary on both sides, but as a rule only one is affected. These cavities are absent in the infant, are very small in children, and hardly have an existence, from a surgical standpoint, until after puberty. Hence operations on them will be confined to adult patients, and they should not be lightly undertaken, for they are by no means free from risk. Fatal meningitis and

osteo-myelitis have followed in several cases the operation of trephining the frontal sinus.* It is difficult to provide proper drainage for the whole cavity owing to its extent and irregular shape, to the frequent existence of spurs or septa of bone which project into it, and to the growth of polypi or masses of granulation

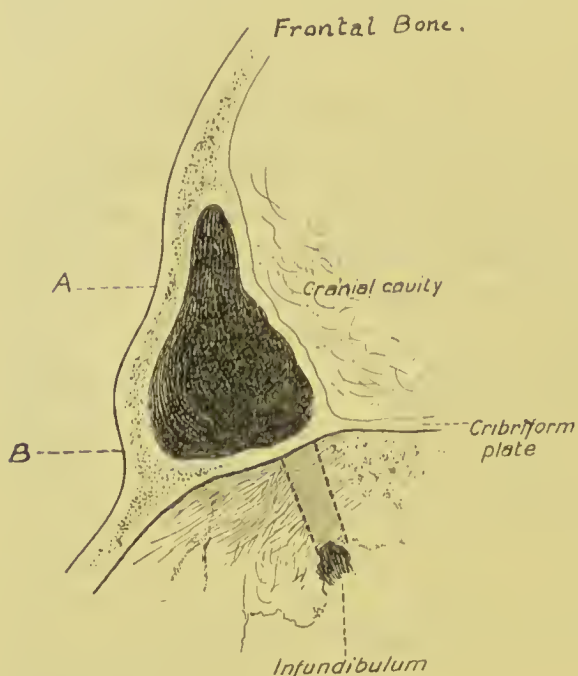


Fig. 465.—VERTICAL SECTION OF RIGHT FRONTAL SINUS.

The piece of bone between the dotted lines A and B would be removed in a radical operation; B marks the nasal notch and floor of the sinus. The thinness of the bone at the back of the sinus should be noted.

tissue in cases of long standing suppuration. The aperture made in trephining the frontal sinus should therefore be placed near the floor of the sinus, and must provide free access, so that any diseased bone or polypi can be removed and the whole cavity thoroughly cleansed. As Fig. 465 shows, the floor of the sinus practically corresponds with the nasal notch. The main cavity of the sinus is opposite to and helps to produce the super-ciliary eminence, and

the cavity is prolonged to a variable degree in three directions. Its upward extension rises for an inch or more between the layers of the frontal bone, the outward one arches above the orbit in some cases nearly to the external angular process, the third extends backwards below the frontal lobe in the floor of the anterior fossa for a variable distance.

In operating, it should be remembered that the front wall of the sinus is usually much thicker than that bounding any other part, and that a Volkmann's scoop or other instrument may penetrate the cranium or the orbit with ease.

* For report of two such cases, see *Brit. Med. Journal*, September, 1892.

The main cavity of the sinus is commonly 10 to 20 millimetres in diameter, and communicates by a channel directed downwards and backwards with the middle fossa of the nose. When the sinus has been opened, this channel (the infundibulum) should be sought for towards the posterior part of the floor, and on a plane slightly internal to the inner wall of the orbit. The normal backward slope of the channel should not be forgotten in passing probes or a drainage-tube. (*See Fig. 465.*)

Special Instruments Required.—Trephines (one of two centimetres in diameter is perhaps the best); small Hofmann's bone-cutting forceps, lachrymal and flexible probes, curettes, irrigator.

The Operation.—The scar left should be as inconspicuous as possible. The incision should follow the natural fold due to the corrugator supercilii, and then bend outwards immediately below the eyebrow, being thus L-shaped. The skin is easily retracted, and a long incision is therefore unnecessary. In dividing and reflecting the soft parts from the bone, care should be taken not to damage the supraorbital nerve or to encroach upon the orbit. The position of the pulley for the superior oblique muscle should be borne in mind. Bleeding will be free from the frontal vessels, and must be stopped before the bone is dealt with. The anterior wall of the sinus being exposed, the pin of the trephine is inserted over the superciliary eminence, about half an inch above and to the inner side of the corresponding orbital angle. The pressure made on the trephine should be of the lightest. The opening can be enlarged as far as necessary with the cutting forceps or chisel.

After the pus has been let out and the cavity irrigated, it should be explored with the probe and finger. Polypoid growths should be cut or scraped away, any necrosed bone cautiously removed, if possible, and the various prolongations of the sinus cleansed by irrigation and use of small pieces of sponge on holders.

A strong antiseptic (*e.g.* one in twenty carbolic acid in alcohol) may be used to swab the cavity out if the pus be very offensive. But all the manipulations should be conducted with gentleness, and the patient's eyes guarded from discharge or antiseptic

solution by means of pads kept over the closed lids. It is rarely desirable to scrape all the lining membrane away, as the healing will be thereby protracted. The infundibulum is sought for, and, if necessary, dilated with probes, but no force should be used to make a new aperture if the normal one cannot be found. If possible, a small rubber drainage tube should be introduced into the nasal opening from above, the other end being brought out under the flap in front. After a few days this tube is withdrawn.

CHAPTER II.

OPERATIONS ON THE MIDDLE EAR, THE MASTOID ANTRUM, AND
ADJOINING STRUCTURES.

1. THE MIDDLE EAR.

THE complications which may attend suppuration in the middle ear and demand surgical interference are many, and the form of the operation will therefore vary much in different cases. In one case suppuration extends back in the cellular tissue over the mastoid process, in another under the periosteum of that bone; in some the mastoid antrum is full of pus which requires evacuation. In very chronic cases of middle ear suppuration a radical operation involving removal of all the tympanic contents and the posterior and upper wall of the meatus has come extensively into practice. Extension backwards of the mischief from the tympanum or mastoid antrum to the lateral sinus may require ligature of the jugular vein and evacuation of the sinus itself. Necrosis of parts of the petrous bone may be due to median otitis, and the removal of the sequestrum may form a special step in the operation. Exploration for cerebral abscess is dealt with elsewhere (p. 740), but not unfrequently the surgeon has gone on to this during an operation which commenced merely in opening the mastoid antrum.

Anatomical Points.—The length, the downward curve, and the relations of the external meatus to the tympanum are shown in Fig. 466, which is drawn exactly twice the size of nature. It will be seen from it that the tympanic cavity projects upwards (as the so-called attic) considerably above the upper margin of the membrana tympani. The roof

of the attic separating it from the dura mater in the middle fossa is often extremely thin and sometimes deficient, and by this route septic inflammation often spreads to the meninges or the temporo-sphenoidal lobe. At the back of the attic is the opening into the mastoid antrum, which will be further noticed. In many skulls this antrum, like the tympanic cavity, is only

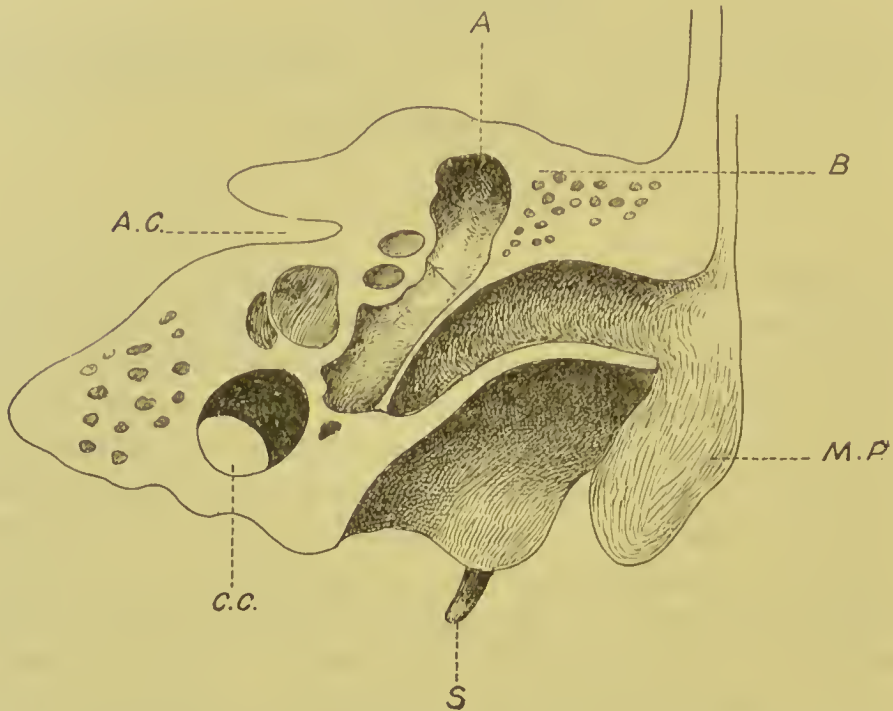


Fig. 466.—SECTION OF TEMPORAL BONE TO ILLUSTRATE THE COMPLETE MASTOID OPERATION. (*From specimen in London Hospital Museum.*)

The section passes downwards and forwards; the posterior half is shown.

M.P, Mastoid process: A.C, Canal for auditory and facial nerves; C.C, Carotid canal; A, Attic of tympanum leading into mastoid antrum posteriorly; S, Styloid process. The dotted line from B to the roof of the attic indicates the line of section required to remove the upper wall of the meatus and the air-cells, which are often invaded by suppuration. The arrow inside the membrana tympani points to the canal of the facial nerve and the horizontal semicircular canal (both seen in section). Above the carotid canal is the cochlea.

separated by a thin layer of bone from the middle fossa. The tegmen tympani and tegmen antri are separated by the projection caused by the superior semicircular canal.

The mastoid antrum and the attic are true extensions of the tympanic cavity, thus differing entirely from the cells in the mastoid process; and there are one or two smaller prolongations which require notice, viz. that forwards and inwards,

which is continuous with the Eustachian tube, and a small one under the bony canal for the facial nerve (aqueductus Fallopii). These recesses are of practical importance to the surgeon when performing the radical operation, in which no recess that contains any focus of suppuration must be overlooked.

Landmarks for the Operation.—It is not merely the depth of bone which has to be traversed that makes the operation a difficult one (occasionally the most experienced surgeon will fail to open the antrum), but the greatest care has to be taken not to injure the lateral sinus or to open into the cranial cavity. Certain landmarks should be borne in mind:—

1. The floor of the middle fossa corresponds externally to a ridge passing back from the zygoma—its posterior root—towards the asterion or meeting of the parietal, occipital, and temporal bones. This ridge can always be felt, as also a slight depression at its hinder end where the parietal bone fits in.

2. The lateral sinus grooves the mastoid process for one-third to one-half of its width, more deeply and extensively as a rule on the right side of the body than the left. Running down obliquely from the depression mentioned above to the anterior border of the mastoid process is a strongly-marked ridge produced by the insertion of the sterno-mastoid muscle. This ridge corresponds, as a rule, fairly closely with the anterior border of the lateral sinus.

As shown in Fig. 468, the operator may safely work in a triangle bounded above and behind by the two ridges described, and anteriorly by the wall of the external meatus. This triangle is nearly equilateral, each side measuring 2.5 cm.= 1 inch. The gouge, etc., should be made to traverse the bone inwards and slightly forwards, parallel to the meatus itself. In young children especially, the cranial cavity is entered with ease, and this accident may have fatal results. It is most undesirable when opening a mastoid antrum full of pus to wound the lateral sinus, as the operation cannot be properly completed, and septic thrombosis is almost certain to follow.

2. TREPHINING THE MASTOID ANTRUM.

This operation is called for in those cases of suppurative disease of the middle ear in which the pus has spread to the mastoid process, and, being retained, is producing more or less serious symptoms.

The operation does not consist of merely opening the nearest cells of the mastoid process, or of driving a boring instrument vaguely into that bone, but is represented by a definite and precise opening of the space known as the antrum of the mastoid. Into this central cavity the mastoid cells open, and it is, moreover, in direct communication with the cavity of the tympanum.

The bone can only be efficiently drained when this particular cell-space is opened up.

The operation is therefore not so much a "trephining of the mastoid cells" as an opening into the mastoid antrum.

Anatomical Points.—In the infant the mastoid as a distinct process has no existence; but in the mastoid segment of the petrous bone is a single air-cell, the mastoid antrum, which communicates by a large opening with the posterior and upper part of the tympanum. Its outer wall is very thin, and thus it happens that in infants pus in the antrum can very readily reach the surface, or be still more readily evacuated by operation. A small incision, extending some two lines into the bone, is all that is necessary. Across the roof of the antrum at this period runs the petro-squamous suture. About the second year the mastoid process becomes visible. As the bone increases, its growth mainly involves its external parts, so that as years pass on the antrum becomes more and more deeply placed. In a child aged nine this cell is about 1 cm. from the surface. At this period no other air-cells exist, but at puberty an extensive series of such cells developes.

In the adult the mastoid cells extend upwards to within half an inch of the temporo-parietal suture. Anteriorly they extend forwards over the external meatus. Posteriorly they cease abruptly at the masto-occipital suture, although in rare

cases they are continued beyond that suture into the occipital bone.

About the centre of the mastoid spaces is the antrum. It is about the size of a pea. Its roof is only separated from the cranial cavity by a layer of bone about 1 mm. in thickness. The distance of the posterior end of the antrum from the lateral sinus is from 3 to 6 mm., while its outer wall is from half to three-fourths of an inch from the external surface of the mastoid process.

The antrum opens into the tympanic attic (*see* Fig. 466) by a canal which lies behind the highest part of the auditory meatus, and the cavity of the antrum is rather nearer the surface than that of the attic. As Ballance points out, a line passing through the mastoid antrum, its aditus, or opening into the attic, and the tympanum forms an angle of about 45 degrees with the antero-posterior plane of the skull.

In tracing the zygoma backwards, we find its upper border continued as a slightly curved ridge to the posterior inferior angle of the parietal bone. The latter can be usually felt as a depression through the scalp. The ridge (shown in Fig. 468) is an important landmark, as it corresponds inside the skull with the floor of the middle fossa, and limits, therefore, the surgeon's interference with the bone in an upward direction. In other words the gouge, if applied over or above this supramastoid ridge, will penetrate into the cranial cavity—an accident especially dangerous when operating on a child's mastoid process.

In Fig. 468 the dotted line *m* indicates the area of bone which it is, as a rule, advisable to chisel away in order freely to open the mastoid antrum in acute cases. The surgeon must work parallel to and close behind the upper part of the meatus just below the supramastoid ridge.

Opening of the Mastoid Antrum.—Of the many special instruments employed or advised for this operation, few have much claim to serious consideration.

Drills of any kind are to be avoided as dangerous. The surgeon has little control over their movements; they are apt to cut deeper than was intended, and are most readily carried beyond their mark.

Trephines are clumsy and needlessly destructive. In children the orthodox "mastoid trephine" would cut away the greater part of the mastoid bone. They are not under very complete control, and there is no indication conveyed to the hand of the moment when the antrum is reached.

Instruments Required.—The best instrument for opening the antrum is a sharp steel gouge, with a handle ending in a broad round knob (Fig. 467). Two gouges, one about 5 mm. wide in cutting edge, the other about 10 mm.; a metal mallet; fine flexible probe; curettes; Volkmann's scoops; a syringe; and Stacke's protector should be at hand, besides the usual cutting and hæmostatic instruments.

Steps of the Operation.—The meatus is syringed out and cleansed as far as possible, the external ear and skin over



Fig. 467.—MASTOID GOUGE (*Sir Victor Horsley's Pattern*).

the mastoid process disinfected. The adjacent scalp should have been shaved and the head enveloped in a sterilised towel over a waterproof cap. The auricle being held forward by an assistant, the surgeon makes a slightly curved incision downwards from the supramastoid ridge towards the apex of the mastoid process, parallel to the posterior wall of the meatus. A small transverse incision is usually required near the upper end of the main one. The knife goes right down to the bone, with due care not to penetrate it in the case of a child's thinned mastoid process. With a rugine the soft parts are peeled backwards and forwards until an area corresponding to the dotted line *m* in Fig. 468 is exposed. The bone enclosed by this line is then gouged away bit by bit.

The instrument is directed forwards and inwards parallel with the long axis of the meatus. It is convenient to introduce a short piece of pencil or of gum-elastic catheter into the meatus as a guide, and to keep the gouge exactly parallel with it.

If the instrument be directed inwards at right angles to

the surface of the skull at the point indicated, the antrum will certainly be missed, and the lateral sinus almost as certainly opened. The direction followed by the gouge is therefore of the utmost importance.

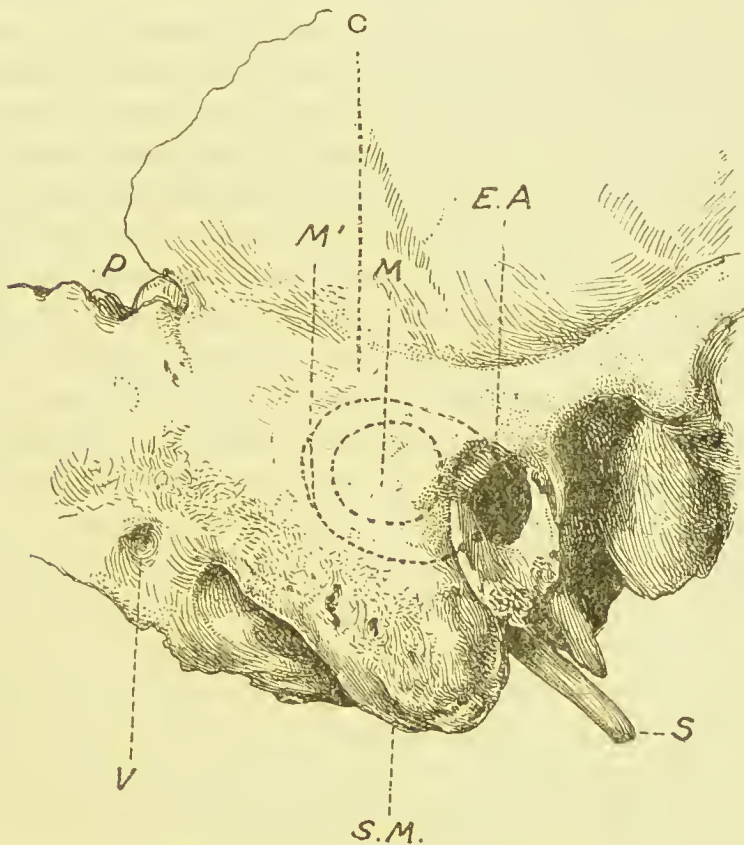


Fig. 468.—EXTERNAL SURFACE OF PETROUS BONE.

E. A, External auditory meatus ; S, Styloid process ; S. M, Rough surface of attachment of sterno-mastoid muscle ; C, Supramastoid crest of bone continued back to P, the postero-inferior angle of parietal bone ; V, Mastoid foramen giving exit to a vein ; M, Dotted circle indicating area cut through in trephining the mastoid antrum ; M', Area of bone removed in the complete mastoid or radical operation.

In the adult the antrum will be reached at a depth not exceeding three-fifths of an inch. The loss of resistance and the escape of pus indicate when the cavity is opened.

The opening is enlarged to the desired extent by means of the sharp gouge. If any necrosis be present, the gouge will need to be liberally employed.

The tunnel in the bone having been well syringed out, a

suitable drainage-tube is inserted, and the parts are well dusted with iodoform.

Boracic fomentations form the most suitable dressing. Gentle syringing with weak antiseptic lotions should be employed daily, followed by gauze dressings. When all purulent discharge has ceased, the opening may be allowed to close.

Comment on the Operation.—In some cases, particularly those in which there is no otorrhœa but marked swelling of the soft parts, it is unnecessary to do more than make a free opening for the pus, and follow any sinus into the bone with a scoop or gouge. Thus a mastoid cell may be found to require to be cleared out whilst the true mastoid antrum is normal, and should be left alone. Other cases, however, may require that much of the posterior wall of the bony meatus should be chiselled away, or part of the front wall of the lateral sinus. The greatest care, however, should be taken lest the latter vein be wounded, since the only way of stopping hæmorrhage from it is to plug, and to do this probably implies premature close of the operation and grave danger of septic thrombosis. A safe rule is to work near to the back of the meatus and parallel with it, but sooner or later it happens to every surgeon to open the sinus by accident. Another danger in operating on young children, as we have seen, is that of working into the cranial cavity in mistake for the antrum. Occasionally much difficulty is experienced in finding the antrum, which may, indeed, be obliterated by sclerosis due to old inflammation.

3. THE COMPLETE OR RADICAL MASTOID OPERATION.

In certain cases of long-persisting otorrhœa with marked loss of hearing, an operation is performed which involves removal of the remains of the membrana tympani, the small bones of the ear, and the posterior wall of the meatus, so as to convert the tympanum and the mastoid antrum into one cavity. This is lined either by flaps from the soft tissues of the meatus or by epithelial grafts.

The Operation.—The proceeding will be understood from the following abstract by Dr. W. H. Harsant of Mr. C. A. Ballance's paper:—

“The complete mastoid operation has received a new impetus by the work of Mr. Charles A. Ballance. In an important paper read before the Royal Medical and Chirurgical Society on January 23, 1900 (*Transactions*, lxxxiii., page 125) this surgeon brought forward a modification of the operation, which was received with much favour, and which is being extensively practised at the present time. Mr. Ballance began by pointing out that the successful conduct of the operation for chronic otorrhœa requires the fulfilment of two conditions: (1) The removal of all disease by operation; (2) the healing of the large wound from the bottom.

“In order to carry out the second condition, it had been necessary to tampon the cavity at frequent intervals with strips of dry antiseptic gauze. This process, however carefully carried out, is painful; and as it requires to be continued for many weeks or months before cicatrisation is complete, it is often neglected, and the result of the operation is not satisfactory. In order to obviate the painful, prolonged, and unsatisfactory after-treatment of the operation, he proposed that chronic otorrhœa should be treated by two operations instead of one. The first operation he would call *the operation for the removal of the disease*; the second operation he would call *the operation for the healing of the wound*. The latter would be attained by the epithelial grafting of the tegmina antri and tympani, of the inner walls of the antrum, attic, and tympanum, and of the fresh-cut bone forming the anterior and superior walls of the inner extremity of the enlarged osseous meatus.

“*Description of First Operation.*—The incision is made behind the pinna, and the latter held forward with a rake retractor. A round cross-cut burr, driven by an electric motor, is used to open the bony cavity, but when no motor or burr is available a gouge is recommended; and while this is being used a Stacke’s protector serves to shield from injury the tuberosity which projects from the inner wall into the neck of the antrum, and contains the Fallopian aqueduct and the horizontal semicircular canal. The posterior wall of the osseous meatus is removed with a pair of small angular bone-cutting forceps. Sharp spoons of various sizes are used to remove the diseased

granulations and soft parts from antrum, attic, and tympanum. The tegmina antri and tympani, and the inner walls of these cavities, should be left by the spoon clean and hard. A bright light is required to do this well, and temporary plugging with dry gauze is an important aid. The cartilaginous canal is next dealt with. Its inferior wall is divided vertically well into the concha. The cut in the concha is then carried with a curve upwards and backwards till it reaches the level of the anterior commencement of the helix. The posterior wall of the meatus is then pushed upwards and backwards, and attached in a special manner by one, two, or three silkworm-gut threads to the mastoid flap. The bone cavity is then plugged with gauze through the meatus.

“Under favourable circumstances the second operation may be done a week later, but in adults not for two or three weeks.

“*Description of Second Operation.*—An anæsthetic having been given, the original incision is again opened; this being easily accomplished by the handle of the knife. The pinna is now displaced forwards, and care taken to arrest all oozing from the granulating surface. The tympano-antral cavity must be rendered quite dry by little pieces of gauze held on forceps. Large epithelial grafts, as thin as possible, are now taken from the thigh or arm. If the surgeon is successful in cutting an epithelial graft large enough to cover the whole area of the granulating surface, it can be applied with advantage in one piece. The graft is best carried to the wound spread out on a microscopic section lifter. It should be made to cover (1) the anterior wall of the cavity formed internally by the anterior boundary of the tympanum and attic, and externally by the anterior wall of the enlarged osseous meatus; (2) the anterior part of the roof of the cavity formed by the tegmen tympani and the superior wall of the enlarged osseous meatus; (3) the inner walls of the attic and tympanum; (4) the tegmen antri; (5) the ridge formed by the Fallopian aqueduct; and (6) the inner wall of the antrum.

“As an aid in pressing the epithelium graft firmly into the cavity, steel probes or stoppers are recommended with pear-shaped heads. As a protective to the grafts, gold-leaf should

be applied over them and carefully pushed into position, after which a narrow strip of dry iodoform gauze is packed into the cavity and allowed to remain for a week. The gold-leaf may be left undisturbed for three or four more days; it should then be removed with forceps. Twenty cases are recorded, all more or less successful."

Comment on the Operation.—The reason for failure in the above operation is the fact that the epithelial grafts do not always adhere well to the bone. In many cases the appearance for a week or two after grafting is flattering enough, but then one or more of the grafts is shed, and the otorrhœa returns. It is, moreover, difficult to ascertain when the bony surface on which the grafts are to be put is sufficiently aseptic to warrant the procedure. As a matter of fact, some of these "radical operations" are not limited to two stages, but may involve as many as six or seven before a cure is finally obtained.

Many surgeons, whilst recognising the value of Mr. Ballance's plan, prefer, as a rule, to turn back suitable flaps from the detached posterior wall of the auditory meatus, rather than trust to epithelial grafts. Two small flaps with their bases made respectively at the upper and lower border of the meatus are perhaps the most suitable. It is impossible to make them correspond exactly to the uneven area of bone, but any small gaps left will close over in time. The flaps are kept in place by means of pressure through gauze-pads which are changed every day, and a weak antiseptic lotion is syringed into the cavity each time they are changed.

The "radical mastoid operation" is not performed with the object of improving the patient's hearing (which, indeed, is often rendered worse by it), but in order to cure the persistent otorrhœa and to remove the risk of intracranial complications. During its performance great care should be taken not to damage the facial nerve as it runs in its bony canal, the aqueduct of Fallopius. This canal is placed vertically on the inner aspect of the cavity which is being excavated, and should any twitching of facial muscles be noticed, the operator should proceed with caution. Temporary or permanent facial paralysis has resulted in some cases from the operation.

4. OPERATIONS ON THE LATERAL SINUS.

The indication for these operations is thrombosis by extension from suppuration in the middle ear. This condition, the distinguishing feature of which is the occurrence of rigors, is best met by trephining over and opening the lateral sinus, and washing out the septic clot through an opening lower down in the jugular vein. By this means many cases have been saved from impending death by pyæmia.

Landmarks for the Operation.—The lateral sinus passes from the inner side of the occipital protuberance forwards and slightly upwards to the postero-inferior angle of the parietal bone. If the ridge on the mastoid process be followed upwards it is found to end in a depression which corresponds to the genu of the lateral sinus, from which the latter bends downwards and inwards, deeply excavating the petrous bone. The sinus leaves the base of the skull just internally to the styloid process, and in front of the transverse process of the atlas. The beginning of the jugular vein is thus inaccessible to the surgeon, being placed so deeply, and if necessary the vein should be exposed lower down below the parotid gland on a level with the thyroid cartilage or hyoid bone. As it grooves the skull, the most accessible part, and that in which thrombosis from ear disease usually occurs, is the genu and the next inch of the descending portion. If a line be drawn backwards from the lower border of the nostril through the middle of the external auditory meatus, and the pin of the trephine be placed $1\frac{1}{2}$ inches on this line behind the centre of the meatus, it will be directly over the lateral sinus. It is quite possible in some cases by trephining very carefully to lift off the bone from the wall of the sinus without damaging the latter, but in old subjects especially this may prove impossible. It is useful in doubtful cases to expose the wall of the sinus, and to judge by inspection or aspiration with a fine needle whether the contents are normal or not. It may be noted that the lateral sinus, as a rule, lies in a deeper groove on the right side than on the left.

Steps of the Operation.—Supposing in a case of suppuration in the middle ear repeated rigors with local symptoms

have made it certain that there is thrombosis, the internal jugular vein should be exposed in the upper part of the neck by an incision over the anterior border of the sterno-mastoid muscle. Care should be taken to avoid the descendens noni and pneumogastric nerves. The vein should be isolated after its sheath has been opened for an inch of its course, and a catgut ligature is put round it, after which the vein is clamped above and divided. The lateral sinus is then exposed by means of a one-inch trephine, the pin of which is inserted at the point already mentioned. The sinus is opened after its wall has been further exposed by cutting forceps, working in the downward direction. All septic clot is then removed by means of a scoop, by small pieces of sponge, and by irrigation. If the clot has extended backwards along the horizontal portion it should be removed, and the surgeon should only be satisfied if healthy blood flows out of the upper end of the sinus, and if a clear current of antiseptic solution can be syringed through the severed jugular vein from which the clamp has been removed. Hæmorrhage from the upper end will be stopped by plugging with antiseptic gauze, and a second catgut ligature should be placed on the divided vein.

As the diagnosis of lateral sinus thrombosis is not easy, it may happen that a healthy sinus and vein have been exposed. In this case care should be taken that the wounds do not get contaminated from the ear discharge. After operation for lateral sinus thrombosis, trephining may have to be done for an abscess in cerebrum or cerebellum. Of this Mr. H. F. Waterhouse records a striking case in the *Med. Soc. Trans.*, 1901, page 179.

CHAPTER III.

EXCISION OF THE EYE-BALL.

Instruments Required.—Eye speculum; strabismus hook; strabismus scissors; toothed forceps; blunt-ended scissors curved on the flat; small sponges.

The Operation.—The patient's head is a little raised, and the surgeon stands in front, facing the patient.

The speculum is introduced between the lids and opened.

With the blunt-pointed scissors the surgeon snips through the conjunctiva just behind the corneal margin. The toothed forceps are used to pick up the membrane and to steady the globe. The division of the conjunctiva is complete all round.

By the further use of the scissors Tenon's capsule is freely opened, and each of the rectus tendons is then picked up in turn with the strabismus hook, and is divided close to the sclerotic with the strabismus scissors. It is convenient to begin with the external rectus, then to divide the superior and inferior recti, and to finish with the inner rectus. If the speculum be now pressed back into the cavity of the orbit, the eyeball starts forwards. The blunt-ended scissors curved on the flat are then introduced into the orbit to the outer side of the globe, and are carried back until the optic nerve is reached. It is divided by one cut of the blades.

The eye-ball being drawn forwards with the fingers, the oblique muscles are divided, together with any soft parts which may still hold the globe in place.

A piece of Turkey sponge is then pressed into the cavity of the orbit, and is allowed to remain there for a few minutes.

The first dressing consists merely of an aseptic sponge pressed into the cavity of the orbit over the closed eyelids,

and retained in position by a pad and bandage. This is taken out at the end of twelve hours or earlier, and the subsequent treatment consists of daily irrigations, and the dressing of the part with a pad of wool soaked in boracic lotion.

If the globe be collapsed, as is frequently the case when excision is carried out, the operation becomes a very meagre affair, scarcely removed from the humble procedure of detaching a slough with scissors and forceps.

It is well in these cases, however, to take care to remove the globe alone, and to leave the muscles with as little of their substance displaced as possible.

CHAPTER IV.

OPERATIONS UPON THE SPINE AND SPINAL CORD.

ON June 12, 1888, a paper was read before the Royal Medical and Chirurgical Society by Dr. Gowers and Sir V. Horsley, which dealt with the case of a man from whose spinal cord a tumour had been removed with success. This paper may be said to form the foundation or starting-point of the more modern phase of spinal surgery.

History.—Operations upon the spine in certain cases of injury are of some antiquity. In instances of fracture in which broken or displaced portions of bone were pressing upon the cord, the injured region has been exposed, and the fragments have been removed. This procedure, known usually as “trephining the spine,” was attended, before the days of antiseptic surgery, with such lamentable results as to cause the measure to be regarded by many as totally unjustifiable.

One of the earliest of the more formal operations was carried out in 1814 by the younger Cline. The patient died; but the method of treatment excited considerable notice, and drew forth much adverse criticism. A successful case operated upon by Sir. W. Macewen in 1885 (*Brit. Med. Journ.*, August 11, 1888) marks a new era, and since then a large number of successful cases has been recorded.

Dr. William White, of Philadelphia, has given an admirable *résumé* of these earlier cases in a paper published in the *Annals of Surgery* for July, 1889. He has collected thirteen recent examples of operation for fracture, with only one death.

Operations upon the spine in cases of paralysis due to pressure by inflammatory exudations, or displaced or deformed bone in Pott's disease, are of much more recent date.

On May 9, 1883, Sir William Macewen removed the laminae of the fifth, sixth, and seventh dorsal vertebræ in a case of complete paraplegia of two years' duration, depending upon angular deformity of the spine. The patient made a complete recovery. The

number of cases of like character operated upon since this date has been numerous. Sir V. Horsley reports seven as performed by himself, with one death from exhaustion at the end of six weeks (*Brit. Med. Journ.*, December 5, 1890).

Among other cases to which reference may be made are those of Mr. Lane (*Lancet*, July 5, 1890), Mr. Herbert Page (*Lancet*, December 6, 1890), Dr. William White (*Annals of Surgery*, vol. ix., page 425), and Krasko (*Zentralblatt für Chirurgie*, November 25, 1890). Out of twenty-three cases collected by Mr. Herbert Page (*loc. cit.*), an improvement more or less considerable followed in about half. M. Chipault (*Arch. Gén. de Méd.*, December, 1890) has brought together thirty-five cases of operation in Pott's disease, the examples of improvement showing a somewhat higher percentage.

The examples of operation for tumour have, up to the present time, been very few.

The surgeon interested in this branch of operative surgery should consult Thorburn's valuable work on "The Surgery of the Spinal Cord."

Instruments Required.—Stout and fine scalpels; trephine; bone-cutting forceps; rugine; elevator; necrosis forceps; chisel and mallet; retractors; blunt hooks; probe; Volkmann's spoons; fine tenaculum-pointed forceps; fine scissors; small curved needles and needle-holder; straight needles; ligatures; sutures, etc.

The Operation.—One of the most lucid accounts of the operation is that given by Dr. William White, and it has been, to a great extent, followed in the appended description:—

The patient lies in a prone or semi-prone position, and a gentle curve is given to the spine by means of a small hard pillow placed under the lower ribs.

A long incision is made in the median line, exactly over the spines of the vertebræ, in the region it is desired to expose.

The incision is carried deep down, and the muscles are freely separated from the sides of the spinous processes and the posterior surfaces of the laminæ by the knife, aided by the rugine. One side is cleared, and all the bleeding arrested, before the other side is exposed in like manner.

A considerable portion of the spine being now exposed, the periosteum is divided along the angle between the spinous processes and the laminæ, and is then reflected from the

surfaces of the vertebral arches by means of a curved rugine. Firm rectangular metal retractors are needed at this stage of the operation. Sir V. Horsley divided the deep fascia at right angles to the line of the incision in one or more places. Gordon severed the muscular bundles attached to the articular processes, in order to obtain a fuller view of the neural arches.

The spinous processes are now divided close to their bases by means of large, strong, bone-cutting forceps, with blades set at an obtuse angle. It is now necessary to divide the laminae on each side, in order to expose the vertebral canal. Some surgeons have used a trephine for the purpose—a not very convenient instrument; others have employed Hey's saw, or the chisel and mallet, or bone-cutting forceps. The method employed must depend upon the surgical habit of the individual surgeon.

In any case, some trouble may be anticipated from the very tough ligamentum subflavum. The laminae should be divided as near to the transverse processes as possible. When the neural arch has been removed to a sufficient extent, the dura mater is well exposed. The operation may end here. The excision of the laminae may have removed the injurious pressure from the cord, or displaced fragments of bone may require to be taken away, or pus or an extradural collection of blood may be evacuated, or an extradural tumour may be excised.

The hæmorrhage in this part of the operation has never been so extensive as arguments based upon theoretical grounds had predicted. It has been in nearly every instance easily and permanently arrested by moderate pressure.

If it be determined to open the dura mater, it is seized in the middle line with fine tenaculum-pointed forceps, and is opened vertically—either by a small scalpel, or, better, by means of fine scissors. When the divided parts are retracted upon either side, the whole of the posterior surface of the cord is well exposed.

Any tumour detected is dealt with by simple excision. (*See the section on tumours of the brain, page 744.*)

The opening in the dura mater is closed by many points

of fine catgut, introduced by means of a curved needle in a needle-holder.

A drainage-tube is now placed along the whole length of the wound, in its deepest part. The muscles are brought together above it by means of catgut sutures; after which the superficial parts are united by sutures of silkworm gut.

An escape of cerebro-spinal fluid has continued for some days or weeks after the operation. A careful suturing of the dura mater should prevent this.

The length of time during which the patient must remain in the recumbent position will depend upon the nature of the case, and the extent and character of the operation. It will usually be advisable that a spinal jacket or spinal support should be worn for some little time after the patient gets up.

CHAPTER V.

TREATMENT OF PSOAS ABSCESS.

IN a paper read before the Royal Medical and Chirurgical Society in June, 1884 (*Med.-Chir. Trans.*, vol. lxxvii.), I urged the evacuation of psoas abscesses through an incision in the loin, and gave the details of the operation, which is described below. The incision is so placed as to open the abscess directly, and at its most dependent spot (when the patient is recumbent). At the same time it allows of the bodies of the vertebræ being examined with the finger, and enables the surgeon to remove carious and necrosed bone by such means as are employed in like affections elsewhere. In the first case operated upon (June 1, 1883), I removed from the body of the first lumbar vertebra a sequestrum measuring one inch by half an inch, which represented all that remained of the centrum. Since that time I have removed smaller fragments of dead bone, and have been able, by means of long and conveniently shaped gouges and sharp spoons to scrape away carious bone from the anterior surface of the column.

The incision allows of a direct exposure of the diseased area, and of the evacuation of the pus by the shortest possible route. The wound, moreover, is made through a comparatively unimportant district.

I have carried out the method of treating psoas abscess in a large number of cases with most excellent results.

At first I merely evacuated the abscess and drained it. In later years I have treated the cavity in the manner herewith described.

Opening of the Abscess.—The patient's loin having been exposed, a vertical incision some two and a half inches in length

is made through the integuments. The centre of this cut should lie about midway between the crest of the ilium and the last rib, and the cut should be so placed as to correspond to a vertical line parallel with the vertebral side of the outer border of the erector spinæ. I find that the average width of the erector spinæ in this situation is, in the adult, from two inches and three-quarters to three inches. The incision, therefore, should be situated about two and a half inches from the lumbar spinous processes.

After cutting through the superficial fascia the dense aponeurosis is exposed which covers the posterior surface of the erector spinæ, and which is variously known as the superficial layer of the lumbar fascia, as the aponeurosis of the latissimus dorsi and serratus posticus inferior muscles, and as the inferior part of the vertebral aponeurosis. The part of this layer exposed in the lower half of the incision is wholly tendinous, but from that seen in the upper half of the cut arise some of the fibres of the latissimus dorsi. These fibres are thin, and pass from below obliquely upwards and outwards. The dense aponeurosis with its attached muscular fibres having been divided in the full length of the incision, the erector spinæ is exposed. This muscle is at once recognised by the vertical direction of its fibres. The outer border of the muscle should now be sought for, and the whole mass drawn by means of retractors as far as possible towards the middle line of the back. In this way the anterior part of the sheath of the muscle, known as the middle layer of the fascia lumborum, is readily exposed. Neither in front nor behind has the erector spinæ any direct adhesion to its sheath at this part.

The anterior layer of the sheath, as now exposed, is seen to be made up of dense white glistening fibres, which are all more or less transverse in direction. Through this sheath the transverse processes of the lumbar vertebræ should be sought for. The longest and most conspicuous process is that belonging to the third vertebra. It is readily felt. The erector muscle having been drawn as far as possible towards the middle line, the anterior layer of its sheath must be divided vertically as near to the transverse processes as convenient. By this

incision the quadratus lumborum muscle is exposed. The muscle as here seen is very thin. It is composed of fibres which run from above obliquely downwards and outwards. Between the fibres are tendinous bundles which spring from the tips of the transverse processes. The muscle should be divided close to the extremity of a transverse process, and the incision cautiously enlarged until the muscle is divided to the full extent of the skin wound. It is at this stage that there is danger of wounding the abdominal branches of the lumbar arteries. The inner edge of the quadratus is overlapped by the psoas muscle, so that when the former is divided the latter is exposed. The psoas fibres, as now seen, take about the same direction as the posterior fibres of the quadratus—*i.e.* run downwards and outwards. The interval between the two muscles is marked by a thin but distinct layer of fascia, known as the anterior lamella of the fascia lumborum. Some of the tendinous fibres of the psoas having been divided close to a transverse process, the finger is introduced beneath the muscle, and gently insinuated along the process until the anterior aspect of the bodies of the vertebræ is reached. The incision in the psoas can be enlarged to any extent.

If the patient were stout or very muscular, the length of the skin wound would have to be increased, or a transverse cut might be made into the erector spinæ to allow of its more effectual retraction.

With common care there should be no danger of opening up the subperitoneal connective tissue, much less of wounding the peritoneum. All risk on this score will be avoided by making the incision in the quadratus as near to the transverse processes as possible.

Great care must be taken not to wound the lumbar arteries. The abdominal branches of these vessels run for the most part behind the quadratus lumborum. That, however, from the first vessel runs in front, and not unfrequently those from one or two of the larger arteries follow its example. These vessels may be of large size—often as large as the lingual. They may be avoided, as well as the trunks from which they arise, by keeping close to a transverse process. The main vessel curves

around the spine between the transverse processes, and between these processes also the division of the artery occurs. If, therefore, the rule be observed of always reaching the spine along a transverse process, the lumbar arteries and their abdominal branches need be exposed to no risk.

In actual practice the operation is often much simpler than may appear from this description. The patients are usually young and thin—often very thin. If the disease have lasted for any length of time, the muscles about the part are found to be atrophied; and if any moderate deformity exist, it serves to render the morbid region more easy of access. The moment, moreover, that the quadratus is incised the psoas is reached, and here will in all probability be found an abscess cavity which will immediately conduct the surgeon's finger to the seat of the disease. As to which loin should be selected—the right or the left—it matters little. The operation can be somewhat more conveniently performed upon the right side, while upon the left the risk of damaging the peritoneum by an accidental slip is reduced to a minimum.

It must be borne in mind that when much angular deformity exists the space between the last rib and the iliac crest becomes much encroached upon. Indeed, the rib may touch and even overlap the pelvic bone. Cases, however, where the space available for this operation is seriously narrowed are not common, are mostly found in instances of extensive disease in the dorsal spine, and are, for several reasons, unsuitable for active treatment.

Treatment of the Abscess Cavity.—As soon as the abscess cavity is well opened, the finger is introduced, and the anterior surface of the vertebral column examined as far as is possible. Such examination is, of course, only called for in cases of disease of the lumbar or dorso-lumbar section of the column. It is easily carried out in children and slender adults. In individuals of large frame it may be impossible.

The surgeon will have all ready at hand many gallons of a solution of corrosive sublimate (1 in 5,000) or of sterilised water heated to a temperature of 100° F., a Leiter's glass irrigator, and suitable receptacles to take the water as it escapes. A liberal supply of waterproof sheets is needed.

A tube of a Leiter's irrigator is introduced into the centre of the abscess, and the eistern being placed at a height of four to six feet above the level of the table, a large stream of the mercurial solution or warm water is allowed to run through the abscess. During this process of irrigation the abscess is frequently emptied by pressure applied to it from the front, and is allowed to fill again and to be emptied again. The patient's position, also, is altered many times. He is turned over towards the sound side, and is then turned almost upon the back, in order that every part of the abscess sac may be well and vigorously flushed.

The surgeon now proceeds to remove as much of the lining membrane of the abscess as is possible. The finger is the safest and most useful instrument.

It is introduced as far as possible. Diverticula from the main abscess are opened up, collections of caseous matter are scraped away with the nail, and here and there the action of the finger may be helped by a sharp spoon. This instrument, however, must be used with caution. It causes bleeding, and often produces a needlessly extensive raw surface. Moreover, the anterior wall of the abscess cavity is usually thin, and the steel instrument may inflict a serious injury upon that part of the parietes.

Next to the finger, the most valuable means of clearing out the abscess cavity is a piece of fine Turkey sponge held in a slender long-bladed holder.

This should be passed in all directions over every part of the abscess wall. The wall should be literally scrubbed with it. It should be gently bored by a rotatory movement into every pocket and diverticulum. The sponge must be changed very frequently.

After a vigorous use of the finger and sponge, the irrigator is again brought into action, and the abscess cavity is once more flushed out, and such *debris* as the sponge has left is swept away. Once again the finger and thumb search out all the recesses of the abscess, and once again the stream from the irrigator follows.

This is done until the abscess cavity appears to be clean,

and until the sponge is returned practically unsoiled. The process is slow and tedious, but it is very effectual. It leaves the abscess cavity bare, and freed entirely of the curdy pus, of the caseous masses, and of the ill-conditioned *débris* which filled it.

Finally, the interior of the abscess is wiped dry with the last set of sponges used, and the wound is closed by a series of silkworm-gut sutures, passed sufficiently deep to include the greater part of the muscular and tendinous structures with the skin.

A pad of dry gauze or of wool dusted with iodoform is placed over the little wound, and is secured in position by a broad flannel bandage.

After-treatment.—The subsequent treatment consists of absolute rest in the recumbent position for a period of months—a period which may easily be too short, but hardly too long. The actual number of months during which the recumbent posture should be observed must depend upon the nature, extent, and stage of the disease. In adults it will probably extend beyond six months in the hands of those who wish to exercise a wise caution. It is not the abscess which is in need of treatment—it is rather the diseased condition which has produced it.

If the period of rest can be carried out at the seaside, and the patient spend the greater part of the time out in the open air (winter and summer) in a spinal carriage, so much the better.

The abscess may re-fill, and may need to be evacuated, washed and scrubbed out, and closed a second time. In no case have I had occasion to carry out a third operation.

If the wound should break down and pus escape at the site of the incision, free drainage and a most liberal irrigation must be the plan of treatment. This has occurred in a few of my cases, and in every instance the patients who have been the subject of this complication have done well. The wound, even in these cases, will heal by first intention, and signs of pus beneath the surface will usually not be observed until a fortnight or more has passed by.

Mr. Barker has employed in these cases an ingenious

instrument, which he terms the hollow or flushing gouge. It consists of a gouge with a tubular handle and shaft, through which water can be conducted into the hollow of the gouge. (*See* page 683, vol. i.) The water, running continuously through the instrument, washes away all *débris* as soon as it is loosened by the gouge.

The *modus operandi* is thus described (*Brit. Med. Journ.*, February 7, 1891):—

A two-inch incision is made through sound structures over the lower end of the swelling. Through this opening a hollow gouge is inserted, which is connected with a reservoir of hot water at 105° to 110° Fahr. by a rubber tube some six feet long. This reservoir (a three-gallon can) is raised about five feet above the operating-table. When the water is now turned on, it rushes through the long gouge to the fundus of the abscess with considerable force, and the reflux carries the contents of the cavity out by the incision. By gently scraping with the flushing-scoop, the more solid caseous matter is dislodged, the hot water carrying it clear of the cavity at once. Then the walls of the cavity are gently scraped in a methodical manner until the soft lining is loosened and carried away from every part of the abscess. In order to effect this thoroughly, the scoops are made of varying length, so that the deeper parts can be reached. With hot water the bleeding is but slight, if the peeling be done cautiously.

When the water runs out clear after having been carried to all the recesses of the cavity, the instrument is withdrawn. Then any excess of water is squeezed out; and if the deeper parts are accessible, sponges are used to dry out the last traces of moisture. Then two or three ounces of fresh iodoform emulsion are poured into the deepest part of the abscess, and stitches are inserted in the edges of the incision. Before these are knotted, all excess of emulsion should be squeezed out of the cavity. The knotting of the silk sutures then completes the procedure. As no drain-tube is used, a simple dry dressing of salicylic wool is alone required; but it should be laid on in considerable quantity, so as to exert elastic pressure over the whole area of the abscess when bandaged. Such a dressing

may be left on for about ten days, when it is time to remove the stiches, and the wound should then be firmly healed. A piece of salieylic wool secured by collodion at the edges should, however, be laid over it, to keep it from chafing, for a few days longer, and the elastic pressure also should be kept up.

It appears to me that in less skilled hands than Mr. Barker's some risk may be run in using this sharp-edged instrument in such an abscess as that found in the psoas muscle. The anterior wall of the abscess is often thin, and little force would be needed to perforate it. The instrument is passed deeply, and is a little removed from direct control. It is in every way admirably suited for tuberculous abscesses nearer to the surface, and especially to suppurative collections in or about large joints.



Part XV.

OPERATIONS ON THE THORAX AND BREAST.

CHAPTER I.

OPERATIONS ON THE THORAX.

Anatomical Points.—The ribs are placed so obliquely that the anterior end of one rib is on a level with the posterior end of a rib some way below it in numerical order. Thus the first rib in front corresponds to the fourth rib behind, the second to the sixth, the third to the seventh, the fourth to the eighth, the seventh to the eleventh. If a horizontal line be drawn round the body at the level of the inferior angle of the scapula while the arms are at the side, the line would cut the sternum in front at the attachment of the sixth cartilage, the fifth rib at the nipple line, and the eighth rib at the vertebral column. The second rib is indicated by the transverse ridge on the sternum. The lower border of the pectoralis major leads to the fifth rib, and the first visible serration of the serratus magnus corresponds to the sixth.

The intercostal spaces are wider in front than behind, and between the upper than the lower ribs. The widest of the spaces is the third, then the second, then the first. The narrowest spaces are the last four. In normal conditions the first six spaces are wide enough to admit the whole breadth of the index finger.

Beyond the angle of the rib the intercostal vessels lie in a groove on the inferior border of the rib forming the upper

boundary of a space. The vein lies nearer to the rib than does the artery.

The lower border of the lung corresponds to a slightly convex line drawn round the chest from the sixth chondro-sternal articulation in front to the eleventh dorsal spine behind. In the mammary line this would correspond to the sixth rib, in the mid-axillary line to the ninth rib, and in a line continued vertically downwards from the inferior angle of the scapula with the tenth rib. The pleura extends farther down than the lung, reaching in front to the level of the seventh chondro-sternal union, behind to the eleventh dorsal spine, and at the sides to a point some two and a half inches above the lower margin of the thorax. The pleura is in relation with the eleventh rib posteriorly, but not usually with the twelfth.

The following **operations** will be described :—

1. Incision of the thorax, with or without resection of a portion of rib—Thoracotomy.
2. Estlander's operation—Thoracoplasty.
3. Incision and drainage of lung cavities.
4. Treatment of hydatid cysts of the lung.
5. Incision and drainage of the pericardium.

1. INCISION OF THE THORAX—THORACOTOMY.

This operation is carried out in cases of empyema: It consists of opening the suppurating cavity, and of draining it.

As a surgical measure, it differs in no essential from the ordinary method of treating purulent collections elsewhere: *i.e.* by free incision and drainage.

Among the many excellent papers which have been published upon this subject, especial attention may be directed to an admirable monograph by Mr. Godlee in the *Lancet* for 1886 (vol. i.).

Site of the Incision.—This must be influenced obviously by the physical signs afforded by the empyema.

If pus be actually pointing at any one spot upon the surface, the incision may be made there, even if it be necessary to make a second wound to afford more complete drainage.

The sites commonly selected are the sixth or seventh space, just in front of the posterior fold of the axilla, the fifth space immediately external to the cartilages, and the eighth or ninth space just external to the line of the angle of the scapula. The latter situation is the one most usually advised. In children it is perhaps always the best, while in adults it is usually the most favourable.

As Mr. Godlee points out, an opening in the lowest part of the space where the cavity is soonest obliterated is less efficient than one made higher up, opposite to the part of the cavity which is the last to close.

The opening in the sixth or seventh space at the point indicated has the advantage afforded by a very thin covering of soft parts.

The Operation.—The skin around the site of the operation must be well cleansed and thoroughly disinfected.

Chloroform is the best anæsthetic.

The patient is brought to the extreme edge of the table, and is allowed to lie as nearly as possible upon the back.

It is more convenient to the surgeon if the patient be rolled over upon the sound side; but such a position is apt to seriously interfere with the breathing, especially when the patient is under the influence of the anæsthetic.

The arm must be raised, but not beyond a right angle. The lifting of the arm involves a displacing upwards of the skin. Before making his incision the surgeon must note to what extent the integument is displaced by raising the limb, and must make his incision so far above the spot at which it is intended to divide the intercostal muscles as will correspond to that spot when the limb is brought to the side. It is essential that the incision be not valvular, and that the opening into the thorax be quite direct, the skin wound and the deeper wound exactly corresponding.

An incision, from one and a half to three inches in length, is made transversely, so as to correspond to the upper border of the lower rib bounding the space.

The intercostal muscles are divided close to the rib; a director is then gently thrust through into the pleural cavity;

the opening made is subsequently enlarged with dressing forceps and the finger. The tube is very apt to be obstructed later by the rib pressure, and therefore many surgeons make a rule of excising an inch or more of a rib in every case of empyema-drainage (*see* page 786). In the great majority this is certainly the best course.

The pus, if considerable in quantity, should be allowed to escape slowly. The abscess cavity may be examined with the forefinger as the fluid is escaping, or after it has been entirely evacuated. All thick curdy material within reach of the finger should be removed.

Experience has shown that it is unwise to wash the cavity of the empyema out at the time of the operation. All that can be done at first is to provide a free opening for the escaping pus.

If for any reason the incision has not been quite conveniently placed for drainage, a counter-opening lower down in the thorax should be made.

A steel bladder-sound, or other suitable instrument, is introduced into the incision, and its point is made to project in one of the lower spaces upon the instrument thus held. A cut with the knife is made. Two drainage-tubes should, in such cases, be inserted. There is nothing to recommend the plan of passing a single tube from one opening to the other.

The drainage-tubes employed should be large and not too rigid. They should not be inserted at great depth. It is only necessary that their open ends should project into the pleural cavity, and that they should not impinge directly upon the lung. No object can be served by a long drainage-tube.

A great and remarkable variety of drainage-tubes has been employed for these cases. They have been made of very varied materials, and in very varied shapes.

During the earlier days of the **after-treatment** a short length of common drainage-tube answers admirably, and later, when the cavity is contracting, a bent rubber tube, like a soft tracheotomy cannula, answers the purpose. It is important that the tube should have no lateral openings, as otherwise the pus may be forced into the subcutaneous tissues, and set up a severe cellulitis. For the same reason it is well to protect

the edge of the wound from the constant flow of pus by placing a piece of oiled silk between the skin and the opening of the tube.

Above all things, it is most necessary that the tube be well secured, and that every precaution be taken to prevent it from slipping out of sight into the pleural cavity. This accident has occurred over and over again. Flanged tubes, tubes with shields, or tubes held in place by sutures and "buoyed" by long ligatures, are consequently to be recommended.

A convenient method of preventing a drainage-tube from slipping in consists in slitting it longitudinally for an inch or more, turning each of the halves outwards and keeping them so with a safety-pin. To encourage the lung to dilate by preventing air from entering the pleural cavity, several forms of tube with valvular orifice have been introduced, especially for use in the late stage of an empyema. The principle of the valvular orifice—allowing pus to escape, but preventing the entrance of the air—is certainly right, but in practice we have not seen any special advantage resulting from the use of these tubes.

In removing every dressing during the after-treatment, the first care should be to note the position of the drainage-tube. In more than one case an extensive operation has been carried out in order to search for a chimerical drainage-tube, reported to be in the pleural cavity, but, in reality, thrown away with the dressings.

If during the operation an intercostal artery be cut, the surgeon's first care should be to see that the vessel is entirely severed, and not partly divided. This object is attained by passing a small scalpel down to the bone at the bleeding point. I venture to think that the most serious hæmorrhage in these cases comes from partly-divided arteries. If cleanly cut, the little vessel soon retracts. Failing this, pressure may be kept up for a while with the finger or a plug of fine sponge. Should the bleeding still continue, a portion of the adjacent rib should be excised, when there will be no difficulty in directly securing the bleeding point.

After the tube is in place the skin is cleansed, the wound dusted with iodoform, and the dressing applied. The dressing must be of considerable proportions, and may consist of a

loose pad of fine gauze. This may be powdered with iodoform. Over the whole is placed a covering of protective or oiled silk, or fine waterproof sheeting, secured in place by a bandage.

The dressing will need to be changed frequently.

When the discharge has subsided a little, and especially when the escaping matter is offensive, the empyema cavity may be washed out once or twice daily. This is best done by means of a funnel and long tube. A very weak antiseptic solution, at a temperature of about 100° F., should be used. The most usual injections are solutions of corrosive sublimate, 1 in 8,000; of tinctura iodi, 1 in 1,000; and of boracic acid—a cold saturated solution made warm.

Later in the progress of the case a counter-opening may be called for, should none have been made at the time of the operation.

Incision, with Removal of a Portion of a Rib.—In some cases the simple incision described does not permit of a free enough opening being made into the pleural cavity, or does not permit of as extensive an examination being carried out as is necessary. In such instances a small portion of one, or even of two, ribs may be excised. The rib is exposed through the incision already made, and is completely bared of periosteum by a curved Farabeuf's rugine. By thus baring the rib the intercostal artery is avoided. The rib is then steadied with lion forceps or flat-bladed neerosis forceps, and is divided in two places with a fine saw. The section may be completed with cutting forceps, but any attempt—especially in adults—to divide the entire rib by forceps is to be deprecated. By such division the bone is unduly crushed and splintered. About one inch and a half of the rib should be removed.

After its excision the sac of periosteum left behind is cut away. It is at this step of the operation that the intercostal artery is probably divided. It can, however, be most readily secured. By first stripping off the periosteum a division of the intercostal artery at an inconvenient time is avoided. The vessel is turned back with the periosteum. It is well to excise the periosteum thus left isolated, since it may produce, at a later period, an inconvenient mass of ill-formed bone.

2. ESTHLANDER'S OPERATION—THORACOPLASTY.

This operation is carried out in certain cases of empyema of long standing—cases in which no healing follows, in spite of long-continued and free drainage of the purulent cavity.

In such instances the chest walls have contracted to their utmost, the lung lies unexpanded, the pleura is greatly thickened, and although the diaphragm has risen to an exceptional position, there still remains a cavity with rigid walls which can contract no further, and which could never close by the slow and exhausting process of granulation. The operation is a plastic measure, which has for its object the speedy obliteration of this cavity. This is effected by cutting away the rigid part of the wall of the space—*i.e.* the whole of its costal boundary.

Resection of ribs is an operation of some antiquity, but the procedure has only of recent years become a precise and widely-employed measure. Extensive resection of ribs is now much less resorted to than when the operation came first into vogue. We have learnt how frequently it fails of its object, whilst, on the other hand, with patience it can usually be dispensed with. The shock attending the operation is usually severe, and the patient is in a very poor condition to undergo it, hence the mortality is high. Even if the operation is successful, the chest is left deformed and a lateral curvature of the spine is the result. In a case of empyema with long-standing sinus regular respiratory exercises to promote expansion of the lung and the best hygienic surroundings will almost always prevent the resort to Esthlander's operation.

Esthlander, who paid especial attention to the removal of ribs as a plastic measure, published his account of the operation in 1879 (*Revue Mens. de Méd. et de Chirurg.*). A very practical contribution to the subject is afforded by an article of Mr. Pearce Gould's, published in the *Lancet* for February 11, 1888.

The Operation.—The patient having been placed in position and anæsthetised (*see* page 783), the cavity to be treated is thoroughly examined, its full extent is ascertained, and the condition of its interior is determined.

The cavity will be found in the upper or central parts of the pleural space, rather than in the lower.

A special operation must be planned for each case, and it is impossible beforehand to determine how many ribs will have to be resected, or how much of each one will have to be removed.

Success depends upon the removal of the whole of the unyielding bony wall of the cavity, and the limits of the excision are identical with those of the suppurating hollow which has to be closed.

As soon, therefore, as the extent of the cavity is known the extent of the excision is defined.

The ribs usually removed are the second, third, fourth, fifth, sixth, and seventh. The amount excised will vary from an inch or so to nearly the whole length of the bony part of the rib.

In the case of a female aged twenty-five, Mr. Pearce Gould (*loc. cit.*) removed considerable lengths of the ribs from the second to the ninth inclusive. The total length of bone resected was fifty-four inches, giving an average of six inches to each rib. The pleura in this case was nearly an inch thick.

Various plans are adopted for exposing the costal walls. Mr. Godlec recommends a flap composed of all the soft parts covering the ribs. This flap is marked out by a V-shaped or U-shaped incision, and is free below, so as to allow for drainage. This procedure is somewhat serious, involves a great wound, and possibly much hæmorrhage.

Esthlander makes a transverse cut over the centre of an intercostal space, and through this wound excises portions of the two ribs which bound the space. If, therefore, six ribs have to be removed, three of such incisions will be called for.

Jacobson advises the formation of two, three, or more small flaps.

Gould recommends a vertical incision over the central part of the cavity, and this, probably, will be found as convenient a way of exposing the ribs as any.

Each rib is exposed in turn, and is bared of periosteum with the curved rugine. It is then excised in the manner

already described (page 786). The periosteum is removed after each excision.

“If the cavity extends far back towards the spine,” writes Mr. Gould, “it will be found convenient, after removing the front portion of the rib in the usual way, to remove the posterior part from the inside, peeling the thickened pleura off the bone, and applying the cutting forceps from within the chest. The dense cicatricial tissue which will usually be found lining the ribs, and the greatly-thickened pleura must be cut away with scissors and forceps.”

The hæmorrhage attending the operation is often considerable, but is readily controlled.

The operation should be completed with as little delay as possible.

The cavity should be then washed out with sterile water. Very small cavities may be stuffed with fine gauze, and allowed to close up from the bottom.

In dealing with the ordinary cavity, the skin is brought into place by silkworm-gut sutures, and the wound thus closed. A large drainage-tube is introduced into the most dependent part of the cavity; or, if necessary, a special drainage incision may be made.

The operation produces much shock.

There is nothing especial to note in the **after-treatment**. It is that of an extensive and deep wound made in tissues that have been long the seat of inflammatory action.

3. INCISION AND DRAINAGE OF LUNG CAVITIES.

The whole subject of the surgical treatment of pulmonary cavities has been very fully dealt with by Mr. Godlee in an admirable series of lectures, illustrated by numerous cases, published in the *Lancet* for March, 1887.

For precision and completeness these lectures leave little to be desired. Mr. Godlee discusses the history of the operation from the early part of last century, when the surgical treatment of lung cavities was discussed in a somewhat wild and nebulous manner by Sir Edward Barry.

As exact methods of treatment, these operations are of quite recent date.

The cases in which surgical measures may be or have been attempted are thus classified by Mr. Godlee:—(1) Tubercular cavities. (2) Cavities resulting from gangrene of the lung. (3) Cavities resulting from the bursting into the lung of abscesses or other collections of irritating matter from without. (4) Bronchiectases, from whatever cause arising.

The Operation.—The anæsthetic selected is chloroform, which is slowly and cautiously administered, to avoid coughing. The patient should lie as nearly as possible upon the back.

The exact position of the cavity must be made out, and in cases of doubt the aspirating needle should be freely used. Mr. Godlee insists upon “the unwisdom of incising the lung until the presence of pus is ascertained.”

A free incision, some one and a half or two inches long, is made over the site of the cavity or by the side of the exploring needle, and is carried down to the intercostal space. The lung tissue, with the overlying pleura, is most conveniently opened with a medium-sized trocar and cannula, the puncture being subsequently dilated with sinus forceps or dressing forceps.

The cavity should be well opened up, and should, when possible, be explored by the finger. If gangrenous lung tissue be met with, it may be removed. It may be necessary to make a second opening in the cavity at a lower level, in order to secure more efficient drainage. A long soft drainage-tube of full size is employed, and is passed well into the cavity.

It is seldom necessary to excise a portion of the exposed ribs, and when the pus is offensive this course is not advised.

If the cavity should be missed, a tube should be placed in the incision made in the lung, in the hope—which was realised in one case—that the pus may find its way later into the opening.

In the majority of cases adhesions will be found to have fixed the lung, and to have practically obliterated the pleural cavity at the site of the operation.

When no such adhesions exist, the following course is advised by Mr. Godlee:—

“The right method of procedure—though I confess it is not a very easy one—is carefully to stitch the lung up to the opening which has been made in the chest walls. It is a difficult proceeding, because the parts are in a constant state of movement from the act of respiration, and because the lung itself is but ill-suited to retain the stitches that are placed in it, and also because the hole in which the manœuvres have to be carried on is a rather deep one, and mostly obscured by the presence of blood. I have only once had to put this plan into practice, and though here it was only partially successful, it was sufficiently so to show that, with a little more care, the closure of the pleura might have been effected. We found, in this case, at the end of a few days, that a part of the stitching had given way; but as no cavity was reached, no evil consequences as regards the pleura resulted, the wound remaining aseptic. Of course, after the stitches have been placed, the attempt to open the cavity must be postponed for at least a week, and at the end of that time the instruments used must be sharp, and their employment gentle, lest the accident which it is intended to avoid may, after all, happen.”

Should foul pus escape into the pleural cavity, the case must be treated as one of empyema.

Hæmorrhage is seldom troublesome after incision of the lung under the conditions met with in these operations. Any serious bleeding would be met by plugging the cavity with aseptic gauze.

After-treatment.—The cavity is syringed out with a suitable antiseptic solution—preferably, carbolic acid—until all fœtor has disappeared. The drainage-tube must be retained until the discharge has almost, and the expectoration quite, ceased. This rule should be closely adhered to, as the most serious relapses have attended a too early removal of the tube.

It is unnecessary to dwell upon the questions of rest, liberal diet, and the necessity of plenty of fresh air. The sooner the patient can be moved out of doors the better.

4. TREATMENT OF HYDATID CYSTS OF THE LUNG.

The following account has been kindly written for me by Dr. W. Gardner, Lecturer on Surgery at the University of

Adelaide. Dr. Gardner's exceptional experience of hydatid disease gives authority to his remarks. The subject is very fully dealt with by Dr. Gardner and others in the *Transactions of the Second Inter-Colonial Medical Congress* (Melbourne, 1889):—

“The site of the cyst having been mapped out by auscultation and percussion as carefully as possible, an incision about four inches long is then made in the line of the ribs through the skin, which is retracted by means of two loops of silk passed through the divided edges. The periosteum over two ribs is then divided and peeled off with a raspator, and at least three inches of the ribs are removed. Any bleeding points must now be ligatured or twisted, and all oozing stopped by sponge pressure.

“The next step in the operation is to pass a long and fine trocar and cannula in the direction in which the cyst has been localised. If this fail, the needle must be driven in again, altering the direction; but this is rarely required. It must then be noted at what depth the cyst is reached, as evidenced by the escape of clear fluid, or of pus if suppuration has occurred. To facilitate this step, the trocar should be marked off in inches and quarter-inches. If not so marked, the finger must be used to measure, as the cannula is withdrawn, the distance to which it penetrated.

“A long narrow-bladed knife must then be thrust in the same direction into the cyst, and an incision large enough to admit two fingers rapidly made. Two fingers of the left hand are then introduced and the cyst hooked up, the knife laid down, and a Hagedorn's needle, which is held by an assistant, and threaded with kangaroo tendon or silk, is passed through the cut edge of the cyst, visceral and parietal layers of the pleura and intercostal muscles, and handed to an assistant, but not tied. The same manoeuvre is then repeated on the side which is held up by the fingers of the left hand; and this loop is also held, but not tied.

“If the cyst be situated at the base of the lung, a drainage-tube must now be passed into the pleura by the side of the cyst; but if it is situated higher up, it is better to take out a

piece of rib in a convenient situation, and pass a drainage-tube into the bottom of the pleura. The two stiches are then tied, and several others inserted in the same way and tied at once. With the finger as a guide, a pair of rat-trap forceps are introduced, and made to take hold of the mother-cyst. The finger is then withdrawn, and, with the forceps in the left hand, the surgeon gently draws on the cyst—and as it frequently tends to break, he must be prepared with another pair of strong catch-forceps to take a fresh hold—and a little delicate manipulation will deliver the mother-cyst entire. In the process of removal, the rent in the mother-cyst may allow daughter-cysts to escape into the cavity; but it is better to allow them to be washed out later by douching than to run the risk of injury to the wall of the external capsule. A large drainage-tube is then introduced into the cavity, and the extremities of the skin incision are approximated by sutures of gut or horsehair.”

5. INCISION OF THE PERICARDIUM IN PURULENT PERICARDITIS.

This subject has been fully dealt with by Dr. Samuel West (*Med.-Chir. Trans.*, vol. lxvi., page 260; *Brit. Med. Journ.*, February 21, 1891), by Professor Rosentein (*Berliner klinische Wochenschrift*, 1881), and by Dr. Hermann Bronner (*Brit. Med. Journ.*, February 14, 1891), and the operation has been now illustrated by a number of most successful cases.

The amount of pus evacuated has in some cases been remarkable. In one of Dr. West's cases “fully two quarts” were evacuated in a few seconds.

The pericardial sac is more safely opened by means of an incision than by means of aspiration in cases of suppurative pericarditis.

The incision is made in the fourth or fifth intercostal space of the left side, and about one inch to the outer side of the edge of the sternum, in order to avoid the internal mammary artery.

The incision is at first small, and is cautiously deepened. The opening in the pericardium may be at first a mere puncture,

and may then be enlarged by cutting, or dilated with sinus forceps.

When all the pus has escaped, a soft drainage-tube is inserted. The cavity exposed must be kept well drained, and should be well washed out as often as required. The after-treatment differs in no essential from the after-treatment of purulent collections elsewhere.

In many cases a portion of rib has been excised in order to give more free access to the pericardium. It is desirable to avoid opening the left pleural cavity, and as the fluid collects chiefly below the heart, Deguy (*Journal des Practiciens*, 1902, page 36) advises the follow operation:—

1. Median incision directly over the xyphoid cartilage.
2. Subperiosteal resection of this part of the sternum, followed by downward detachment of the muscular fibres of the diaphragm.
3. The pericardial sac is exposed by dissecting through the loose cellular tissue; it is seized by fine-pointed forceps and drawn down.
4. Incision of the pericardium, followed by drainage with gauze or tube.

CHAPTER II.

OPERATIONS ON THE BREAST.

Anatomical Points.—The female breast normally extends from the third to the fifth or sixth rib vertically, and from the edge of the sternum to the outer border of the pectoralis major transversely. Its size, however, varies greatly in different individuals and at different ages. At the period of life when scirrhus most often attacks it (forty to fifty years) the margin of the breast is often ill-defined, and its peripheral lobules are difficult to distinguish from the surrounding fat.

Processes of the gland extend towards the skin, to which they are held by fibrous bands (the suspensory ligaments of Sir Astley Cooper). In Fig. 469 it is seen that these processes are separated from each other by fat, and that they frequently come close to the skin (*see* 6 and 7 in the figure). Hence the importance during an excision of the entire cancerous breast of removing the skin over it freely. On its deep aspect the breast lies closely on the pectoral fascia, in which a cellular interspace allows of lateral mobility and also facilitates the detachment of the breast during the operation from the chest wall. It should be noted that this interspace in the fascia (*see* 11, 12, and 13 in the figure) is freely supplied with lymphatic vessels, which communicate with those of the breast. Hence in the operation it is best to remove the whole of this fascia with the underlying pectoral muscle.

If the whole thickness of the muscle be not removed, at least the surface fibres should be, so as to make sure of excising the fascia and the lymphatics in it.

The breast is supplied by the following arteries, which are divided in excision of the gland:—The second, third, fourth, and fifth intercostal branches of the internal mammary (*see*

branches of the axillary artery and vein to the lymphatic glands will be divided, as well as branches from the subscapular vessels. Care should be taken, however, not to injure the latter.

With regard to the lymphatics of the breast, the great

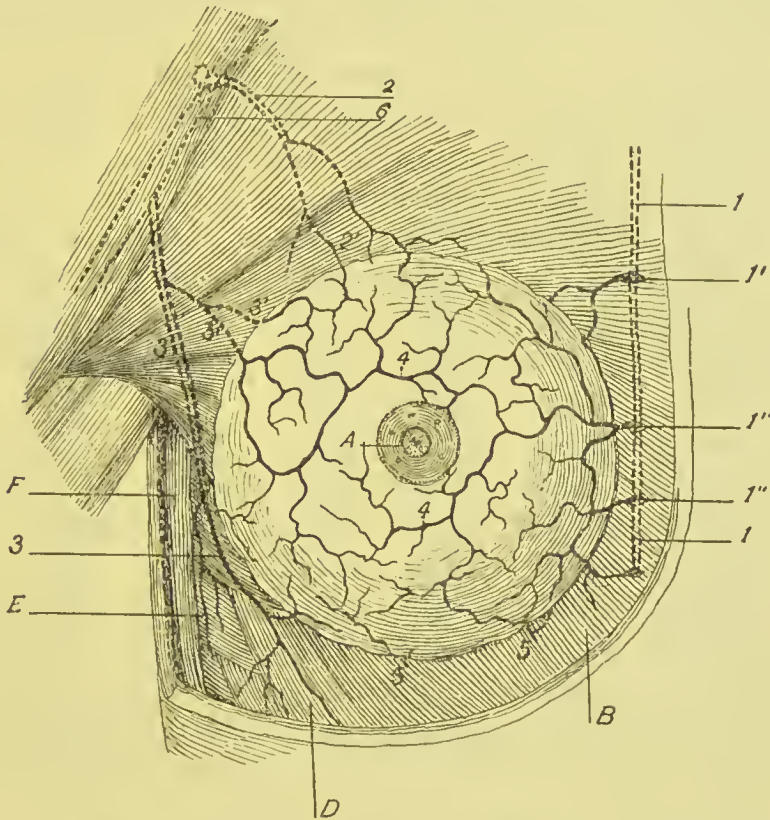


Fig. 470.—ARTERIAL SUPPLY OF THE BREAST. (*From Testut.*)

1, Internal mammary artery; 2, Superior thoracic coming from 6. The axillary. 1', 1'', 1''', perforating branches from internal mammary 5 and 5', others from the intercostal arteries. 3, External mammary from axillary; 4, 4, Anastomotic circle round nipple; A, Nipple; B, Pectoralis major; D, External oblique; E, Serratus magnus.

majority run upwards and backwards into the axilla; some however, accompany the intercostal arterial branches and enter the anterior mediastinal glands. The latter, however, are of small importance to the surgeon, as they derive their lymph from the inner side of the breast, which is rarely the starting-point of cancer. Moreover, in the rare cases of mediastinal glands enlarging from secondary deposit, they are quite inaccessible to the operator.

The upper and outer quadrant of the breast is in nearly three cases out of four the first invaded with scirrhus. The lymphatics run into the axillary glands situated (1) along the lower edge of the pectoralis minor behind the great pectoral; (2) on the serratus magnus, extending up towards the axillary vessels; (3) close to the axillary vein, forming a chain up to the clavicle.

Besides these, a few scattered glands are usually present just behind the pectoralis minor, above this muscle close to the root of the coracoid process, and near the origin of the subscapular artery, or along its course.

The practical deduction from this is that if the pectoralis minor be excised with its fascial investment (the whole suspensory ligament of the axillary), some lymphatic glands will probably be removed with it which would otherwise escape detection.

The only operation on the breast which requires full discussion is its excision for malignant growths, but a word or two may be said with regard to **removal of adenomata**. These tumours are always well-defined and enclosed in a capsule. The incision for the removal of one should be made right down through this capsule, in a line radiating from the nipple. If the tumour is pushed forwards and the skin stretched by grasping the breast firmly with the left hand, a short incision will suffice for the tumour to project and for the surgeon to shell it out.

In excising cysts of the breast, it is never possible to remove them entire without a margin of healthy mammary tissue. After removal of either cysts or adenomata silkworm-gut sutures should traverse the greater depth of both wound-surfaces; in other words, they must not be passed merely through the skin, or a cavity will be left which is certain to fill with blood and delay healing.

EXCISION OF THE BREAST.

Instruments Required.—Several large and small scalpels, such as are shown in Fig. 471. The largest size (No. 5 or 6) is especially suitable for the main incisions. If one knife is used

for cutting into the tumour, it should be at once laid aside and another taken. Dissecting and sharp-pointed forceps; fifteen to twenty Wells's pressure forceps; two pair of scissors; aneurysm needle (occasionally wanted); vulsellum forceps; blunt dissector; needles, sutures, and needle-holder, etc.

Position.—The patient is brought to the edge of the table, and lies with the head and shoulders raised. The arm of the



Fig. 471.—OPERATING SCALPELS MADE IN ONE PIECE OF STEEL FOR ASEPTIC PURPOSES.

With a set of this kind nearly all surgical operations, including amputations, can be done.

affected side is well raised from the side and securely fixed by a bandage applied with clove-hitch round the wrist to the head of the table, so that it cannot move during the operation.

The axilla has been thoroughly shaved and disinfected beforehand. The arm, neck, and abdomen are protected by macintosh sheeting, over which sterilised towels are placed. Finally, just before the operation the skin of the operation area is gone over with alcoholic solution of carbolic acid (1 in 20), or of biniodide of mercury (1 in 500). Sterilised sponges, towels,

or pads of dry absorbent wool are packed between the side of the patient's chest and the operating-table to absorb the blood, which tends to run down over her back.

In dealing with the right breast, the surgeon faces the patient. In dealing with the left gland, he faces towards the hip of the opposite side. The chief assistant in either case places himself opposite to the surgeon, and upon the other side of the table. He leans over the patient's trunk. He helps to retract the parts, to hold up the breast when required, and to grasp any bleeding point with pressure forceps. A second

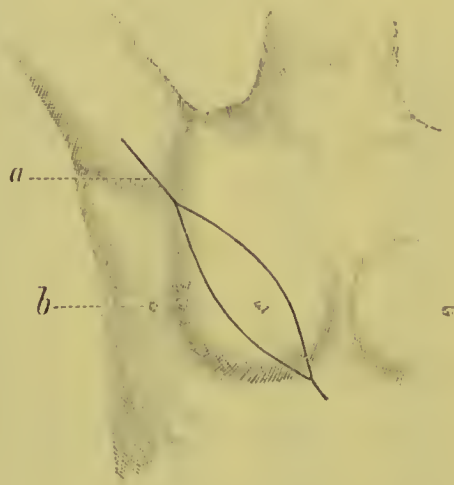


Fig. 472.—EXCISION OF THE BREAST. (*The old or simplest type of incision.*)

a, Axillary incision; *b*, Drainage opening.

Other incisions are shown in Fig. 473.

assistant may stand by the surgeon's side. Both assistants should have pressure forceps close at hand.

Preliminary Incision into the Tumour.—If there is the slightest doubt as to the diagnosis, a short incision should be made into the very centre of the tumour. It has happened to many surgeons to remove a breast containing a cyst or chronic abscess in the full belief that the disease was cancer. The objection to a preliminary incision—that it may infect the surrounding breast-tissues with cancer-cells—is not worth discussing. Of course, the knife used should at once be put aside. It occasionally happens that the incision still leaves the diagnosis in doubt, as there may be one or more cystic spaces with little evidence of true tumour, and sometimes a

breaking-down scirrhus is very like tuberculous mastitis. In such doubtful case the safest policy will be to excise the whole breast.

The Incision, etc.—The exact incision made will vary according to the individual case, though its general form will be elliptical, the centre of the ellipse being about the nipple. The upper end of the incision used to be made through the centre of the axilla, but it is much better to place it well over

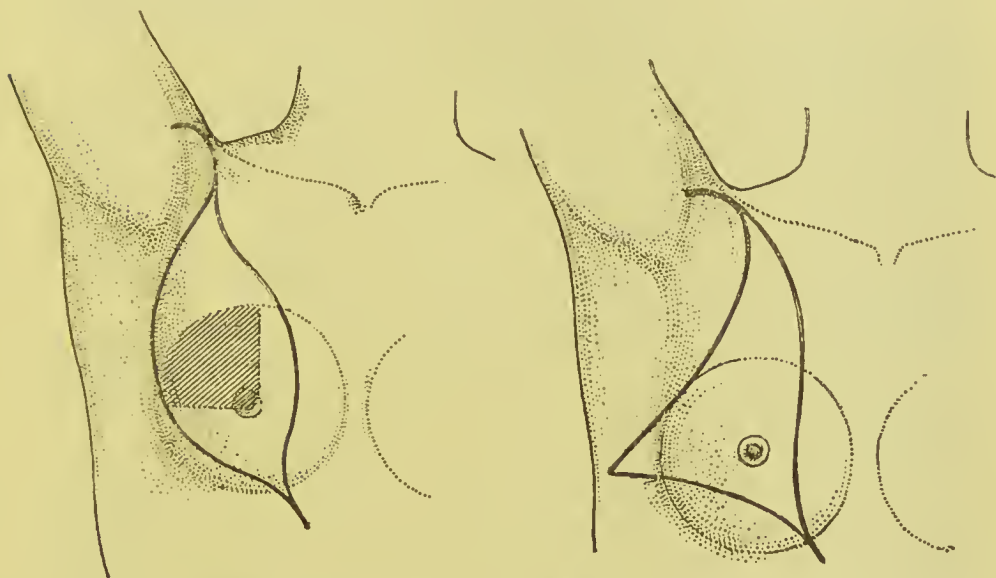


Fig. 473.—INCISIONS FOR REMOVAL OF BREAST AND CONTENTS OF AXILLA, SHOWING MODIFICATIONS ACCORDING TO THE AMOUNT OF SKIN REQUIRED TO BE REMOVED.

In the left figure the shaded area, the upper and outer quadrant of the breast, indicates that part in which scirrhus commences in nearly three out of four cases. In both figures the wound is placed in front of the axilla, and its upper end curves over the pectoralis insertion.

the border of the pectoralis major muscle, tailing slightly downwards across the insertion of the latter (*see* Fig. 473). The reasons for this are: (1) The axillary skin is provided with large hair-bulbs and modified sweat-glands. It is practically impossible to render these aseptic, and hence the wound should not be made through this region of skin. (2) In many cases, probably in all, it is best to remove with the breast the costal or lower portion of the great pectoral muscle, and this is rendered easy by this modification of the old incision. (3) Clearing the axilla, especially the upper part of it between the clavicle

and first rib, is done by open dissection through this incision. By the mid-axillary one this step was effected mainly by finger traction in the dark, with increased risk of venous hæmorrhage.

When adhesions exist between the skin and tumour, the former must be freely sacrificed, as slight delay in healing of the wound is of no importance compared with the risk of leaving nests of cancer-cells behind. In some cases it is advisable to excise a V-shaped piece of skin covering the outer part of the breast as well as that removed by the modified elliptical incision.

In dealing with the right side, the surgeon commences the incision over the axilla and cuts toward the chest.

In dealing with the left breast, it is convenient to commence the incision at its lower part, and cut towards the axilla.

In either case the lower or axillary half of the incision is made first for convenience as to the bleeding. The flap is retracted by careful dissection until the posterior fold of the axilla (edge of the *latissimus dorsi*) is reached.

As the cut is made, the surgeon steadies the part with his left hand, which is made to press in the opposite direction to that followed by the knife, so as to keep the skin tense.

The knife should at first involve the skin and superficial tissues only, and should just pass down into the subcutaneous fat. As soon as the ellipse has been completed the surgeon should turn to the V-shaped point at each extremity of the wound, and should see that the skin is entirely free at these points. It is very common for the mass to be held here, owing to a faulty division of the skin.

The chief assistant, who stands upon the opposite side of the table, now draws the skin up on the sternal side of the mamma towards the median line, while the surgeon lightly presses the breast downwards with his left hand. While the parts are in this position the upper limb of the incision is carried down to the pectoral muscle. If the skin be fully retracted by the assistant, a division of the deeper parts well beyond the limits of the breast is ensured.

The surgeon now grasps the mamma and drags it away from the thorax, while he severs its deep attachments in such a way as to lay bare the great pectoral muscle. The fascia

forming the sheath of this muscle should always be removed, and it makes little difference as regards future use of the arm whether the whole thickness of the costal portion be taken or not. As its removal greatly helps a thorough clearance of the axilla, it may be advised in nearly all cases. In dividing the muscle close to its origin from the sternum and costal cartilages the anterior perforating vessels must not be cut too close to their points of emergence. As a rule they can be secured by pressure forceps before being cut across.

The breast, with the underlying muscle, is now drawn downwards and outwards, and the pectoral insertion divided cautiously so as to expose the axillary vessels, the incision being made at right angles to the fibres. With ordinary care there is no risk of damaging the axillary vein, as a layer of fascia and some fat separate the muscle from it.

Some surgeons recommend that the pectoralis minor should invariably be removed at the same time. This is not always necessary and somewhat increases the severity of the operation. In completing the removal of the breast and axillary contents, the serratus magnus, the subscapularis, the axillary vessels, and nerves will be laid bare. It is well to expose the vein early, and the handle of the scalpel or a blunt dissector will be used to detach the chain of lymphatic glands which runs alongside it. Now and then it may be necessary to excise part of the axillary vein between the ligatures in order to get away adherent glands. This should be avoided, if possible, as the cephalic vein may be deficient, and œdema of the arm is then apt to follow.

The intercosto-humeral nerve will often require to be divided, leading to subsequent numbness at the lower and inner part of the arm, but the subscapular nerves, the corresponding artery and vein, and the long thoracic nerve should be spared. Branches of the subscapular and axillary vessels to the lymphatic glands will necessarily be divided, and all such vessels should, if possible, be clamped before their section.

Careful search should be made for the lymphatic glands which lie close to the coracoid process and first rib, and they should be removed, whether apparently infected or not.

It is now convenient to mention the following *general points*

with regard to excision of the breast:—(1) All bleeding points should be picked up neatly, and not grabbed up together with a mass of the surrounding tissue. (2) The wound should not be scrubbed with a sponge. It barely needs to be sponged at all. (3) Sterilised water should be used to wash the wound. It should be cleansed by washing, and not by sponging. A kidney-shaped receiver is placed beneath the wound, and a stream of warm sterilised water is allowed to run over the raw surface until all clots have been washed away.

The bleeding points are now dealt with. In the majority of cases the long-continued pressure of the forceps will suffice to close the larger number of the vessels, others are occluded by twisting the pressure forceps before they are removed. But as recurrent hæmorrhage is more common after excision of the breast than any other operation, it is best to tie every doubtful vessel with catgut or fine silk. When this has been done and the cavity flushed with warm sterile water, the long wound is sewn up.

The needles employed are straight and long, and the sutures are of silkworm gut. The upper and lower sutures are applied first, the middle ones being left to the last. The sutures are not tied until the upper and lower series are completed. They are then knotted, and the assistant follows the closing wound with sponges, so applied as to maintain considerable pressure over the recently-united incision, and to obliterate the wound cavity. This pressure must not be relaxed. In a few cases an opening for a drainage-tube is now made in the hollow of the skin below the wound (Fig. 472, *b*). A tube is inserted and secured by a suture. The drainage-tube can usually be dispensed with, and it appears to increase the risk of suppuration. From our own statistics of 100 cases treated with and without drainage at the London Hospital we found primary union to be decidedly more constant if the tube were omitted.

The middle sutures—*i.e.* those in the central part of the wound—are now inserted and, when they are all in place, tied. The assistant with the sponges still follows the sutured incision, and obliterates by pressure the wound cavity. The dressing is prepared. It consists of a large pad of sterilised gauze or dry

cyanide gauze, over which sterilised wool is used. The wool covers the whole side of the chest, the opposite breast, the shoulder, and the back as far as the spine.

Until recently it was the custom, after excision of the breast, to bandage the arm of the same side against the chest wall—making, in fact, a splint of it—to keep the dressings at rest. It was usual to maintain the patient's arm in this position for ten days or so, allowing movement neither at shoulder nor at elbow-joint, and sometimes even confining the fingers and hand closely against the thorax. Such confinement is, of course, irksome to the patient, and apt to be followed by stiffness of the joints, which is but slowly recovered from. The axillary vein may become adherent to the side of the chest, and circulation be thereby impeded. Moreover, keeping the arm pressed against the side of the chest encourages axillary perspiration, and may thus favour infection of the wound. As long as the shoulder-joint is kept at rest, freedom of the elbow and hand cannot interfere in the least with healing of the wound. The best way is to envelop the axillary and pectoral region with a large dressing, which is kept securely in place by a figure-of-eight bandage applied whilst the assistant supports the arm at about a right angle from the chest wall. The arm is subsequently supported on a pillow at a little less than this angle. Especially in warm weather, a white bandage is preferable to a flannel one.

After-treatment.—If there be any pain, a hypodermic of morphia may be given on the evening of the operation-day, but this is rarely required. As a rule, the patient complains chiefly of back-pain, and this may be relieved by changing the posture from time to time.

The dressing should be left undisturbed for ten to fourteen days if possible. When the wound is exposed the greatest care should be taken as to asepsis, and the removal of the stitches and change of dressing should be effected with sterilised instruments rather than the fingers, and with a complete avoidance of flushing or free “swabbing” the wound. The manipulations, in a word, should be dry.

If a drainage-tube has been inserted, it should be withdrawn at the end of two days without disturbing the whole of the

dressing. This is easily effected if a suture has been passed through the free end of the tube (not the skin) and left long and dependent.

Comments upon the Operation and Modifications of the Procedure.—In dealing with large tumours, such as some sarcomata, the skin incision must be planned with much care, or the operator will fail to adjust the margins of the wound. If much tension fall upon the sutures at one part of the wound in consequence of an unusual amount of skin having been removed, it is best not to attempt to bring the edges together at this part. After an aseptic dressing has been applied for a week, the raw surface will be found in a good condition for grafting, though this is often unnecessary. The grafting by Thiersch's method may be done at the time of the original excision, but it is probably better to wait a week or more, and the grafts can then be taken without other anæsthetic than cocaine or eucaine being required.

It appears to be totally unnecessary in ordinary cases of malignant disease to remove the *whole* of the skin covering the breast, whether sound or unsound, as some advise. Such skin as is implicated by the disease or adherent thereto must, of course, be freely removed; but if the disease be so advanced that all the integument covering the mamma is involved, then it is probable that the case is not suited for treatment by operation.

Should the Operation always Include Clearing the Axilla?—In no case of scirrhus of the breast is it wise to leave the corresponding axillary glands, since microscopic examination proves that secondary deposits are present in the latter in at least three out of four cases at the time of operation.*

It is often quite impossible to detect the earliest infected glands by palpation; indeed, it may require thorough search in the excised contents of the axilla to find them. Glands completely converted into scirrhus and yet no larger than grains of wheat are often found at the time of operation. The presence of a microscopic deposit of cancer-cells in one axillary

* McWilliams (*Med. News*, April 28, 1900), 78 per cent. The results of many other observers are to the same effect.

gland may render the excision of the breast alone of no real value to the patient. Hence, although the immediate risk of the operation is somewhat increased, excision of a cancerous breast should always include excision of the axillary lymphatic glands. If the supraclavicular glands are suspected, they also should be removed through an additional incision made parallel to and above the clavicle. It must be admitted that when the supraclavicular glands are infected the operation is hardly worth doing.

Small innocent tumours of the breast are removed through a simple incision, which should follow a line radiating from the nipple. If much thickness of mammary tissue is cut through, a drainage-tube should always be retained for twenty-four or thirty-six hours.

It is sometimes possible to remove an innocent growth by an incision which follows the crease between the lower segment of the mamma and the thorax. Excellent drainage is provided by such an incision, and the scar is entirely hidden from view. Usually this method is impracticable without an awkward dissection.

Results of Excision of the Breast.—The actual mortality following the operation of excision of the breast is very low, and is at the present day probably less than three per cent.

The prospect of a cure following the operation has undoubtedly been much increased during the last twenty years, since Moore, Mitchell Banks, Watson Cheyne, and others have taught the vigorous and thorough extirpation of the cancerous breast and all axillary glands in every case suitable for operation. Some have placed the percentage of those who remain free from recurrence as high as 60 to 70 per cent., but this very favourable result is only arrived at by fixing an arbitrary time-limit of three years or so. *There is no such time-limit for the recurrence of cancer.* It may take place ten years or more after an apparently successful operation. However, a proportion of even 40 per cent. of cures by operation in cases of mammary scirrhus is much better than could have been anticipated twenty years ago.

Operation on Recurrent Growths.—When recurrence is

met with in the skin or subcutaneous tissue of the chest-wall, it should certainly be operated on, except in the rare cases of widespread and rapid infiltration, suggesting erysipelas. These last are wholly unsuitable for any further surgical interference. The fact that one or two nodules show themselves a year or two after the major operation is rather an indication that a few outlying cells of the growth have been left behind than that the patient is the hopeless victim of a general cancerous tendency. Even repeated excisions of local recurrent growths occasionally result in permanent cures. Sometimes the recurrence takes place in the remaining breast, and if the conditions are favourable, a second excision may result in a permanent cure. Of this unexpected result Mr. T. Bryant and others have recorded many examples. When the recurrence is so extensive that excision is not worth doing, the operation of oöphorectomy may be performed, as advocated by Dr. Herman and Mr. Stanley Boyd. It was first suggested as a remedial measure in cancer by Dr. Beatson of Glasgow, and has only been tried since 1899, hence it is too early to speak of the exact benefit to be expected from it. The following provisional conclusions may be drawn from Mr. Boyd's collected series of cases and from others under our own observation:—

1. Oöphorectomy in some cases has apparently a definite effect in checking the growth of cancerous tumours; in others it fails entirely.
2. The most suitable cases are those in which the patient is approaching the menopause.
3. It is rarely worth doing if the patient is elderly—*i.e.* over fifty years of age.
4. It is occasionally followed by considerable shock, and should only be resorted to if the patient's age is favourable to the chance of benefit resulting from it.

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